Practical TELEVISION

JUNE 1961

1/6

A Basic TV 'scope

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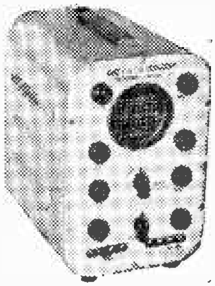

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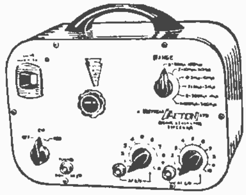

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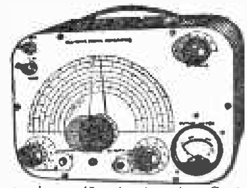

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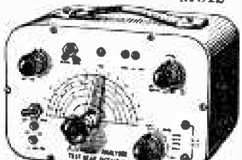

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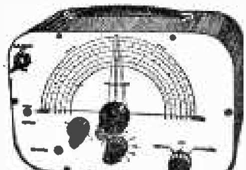

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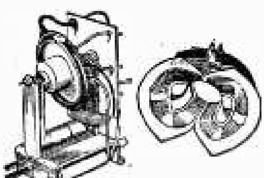

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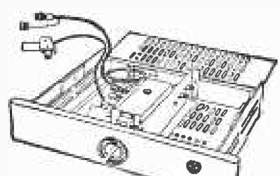

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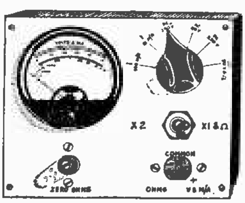

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Practical Television

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Contents

Colour Television

THE organisers of the Radio Show (to be held at Earls Court, London from August 23rd to September 2nd) have sent out a policy statement to prospective exhibitors. The statement says:

"Demonstrations of colour TV will be given at the Radio Show this year by the BBC as part of its celebrations of the Jubilee of Television. These demonstrations will be on a relatively small scale and are intended to show the state of technical progress which the BBC has now achieved in this field . . . The whole exercise will be closely controlled so as to avoid creating any impression that colour TV is 'just around the corner', or that the commencement of a BBC public service in colour is imminent.

"To keep the subject of colour TV in its correct perspective, it has been decided that, except for this one BBC feature, no demonstration of colour TV in any form whatsoever will be permitted during the 1961 Radio Show."

This statement underlines the fact that colour TV in this country is at present very remote—so much so that measures must be taken to prevent members of the public from realising that colour TV has already left the laboratory. The BBC has expressed its eagerness to establish a limited colour service and some of the reasons for the refusal of permission were given recently in the House of Commons by Mr. Bevins, the Postmaster-General. In reply to a question he emphasised that the BBC test transmissions were to continue. He hoped that this would help our manufacturers "to develop a reliable and less expensive receiver which would not require an imported tube." (So far, experimental British sets have American cathode ray tubes.)

Mr. Bevins said also that he rejected the BBC application to start regular colour programmes because he took the view that the question of line definition should be settled first.

However, it is not only the Government who are against the early introduction of a restricted colour service; several organisations have attacked the BBC's campaign. "To introduce colour on 405 lines is exactly as sensible as painting and decorating at great expense a house whose destruction is under discussion" was the comment of Sir Robert Fraser, director-general of the ITA.

Until the question of line definition is settled—which may be several years—it seems unwise to introduce even a restricted service of colour television. If such a service were introduced, then we should be tied to using imported cathode ray tubes, mainly American manufactured. It may well be, that in the near future, British and Continental research teams will evolve a CRT for colour which is better and cheaper than those imported, thus enabling the cost of the sets to the public to be reduced.

Our next issue, dated July, 1961, will be published on June 22nd.

Telenews

Television Receiving Licences

THE following statement shows the approximate number of Television Receiving Licences in force at the end of March, 1961, in respect of television receiving stations situated within the various Postal Regions of England, Wales, Scotland and Northern Ireland.

Region	*Total*
London Postal	1,910,413
Home Counties	1,559,102
Midland	1,693,294
North Eastern	1,820,432
North Western	1,476,963
South Western	957,393
Wales and Border Counties ..	679,523
Total England and Wales	10,097,135
Scotland	1,007,713
Northern Ireland	162,893
Grand Total	11,267,741

More 4½in. Pick-Up Tubes

ALL the camera pick-up tubes for "Studio D", part of A.T.V.'s Television Centre at Elstree, have been supplied by the English Electric Valve Company Limited. The new studio was officially opened on April 7th and each camera is fitted with type 7389 pick-up tubes. The English Electric 7389 4½in. Image Orthicon provides pictures of the highest quality and with the 7295—also manufactured by E.E.V.—is in use in television studios throughout the world.

Film Viewing Theatre

THE supply and installation of 35mm Film Sound and Projection Equipment has been entrusted to RCA Great Britain Limited by Messrs Clifford Bloxham and Partners Limited for use in their new Film Viewing Theatre at Wellington House, Upper St. Martins Lane, London, W.C.2.

The equipment to be provided includes an LG.220P embodying a Preview Attachment for running unmarried picture and sound film prints and includes facilities for reproduction of sound from either standard optical or 200mil studio magnetic recordings. An auditorium remote volume control will be provided, and a special switching arrangement will make it possible for the signal from a tape recorder or non-synchronous disc unit to be fed through the main auditorium loud-speaker system, which is of the Studio Console type.

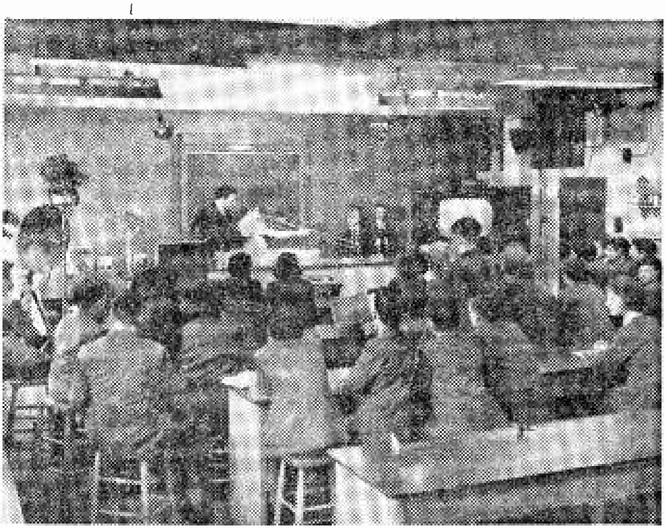
New Managing Director

THE General Manager of The General Electric Co. Ltd.'s Telecommunications Group at Coventry since October 1959, Mr. W. A. C. Maskell, B.Sc. (Eng.), M.I.E.E., F.B.I.M., Sen. M.I.R.E., has been appointed Managing Director of the Group.

Born at Brighton in 1906, Mr. Maskel was educated at Varndean School, Brighton, and at Brighton Technical College, and graduated with a degree in Engineering at London University in 1925.

New Filmstrip "The History of Television."

A NEW filmstrip, "The History of Television", has been added to the range of colour filmstrips introduced by the Mullard Educational Service. It is complementary to an earlier release "The History of Radio", and deals with the history of



Boys of Barnhill Secondary Modern School at Hayes, Middlesex, recently received a science lesson by television; the lesson was in progress at Hayes Grammar School, some two miles away. The two classes were linked by microwave television beams, and the equipment was by High Definition Television Limited, a company of the Pye Group; The illustration above shows the classroom, with TV camera, at Hayes Grammar School.

picture transmission from the middle nineteenth century to the present, and explains fundamental principles to show the significance of technical developments.

Its simple approach makes it suitable for use in Secondary Modern Schools, and the lower forms in Grammar Schools; or in senior classes where science is taught as a general knowledge subject, rather than one for examination.

The filmstrip comprises 28 frames and is immediately available from the distributors, Unicorn Head Visual Aids Ltd., 42 Westminster Palace Gardens, Victoria Street, London, S.W.1., price 25/- a copy including comprehensive teaching notes.

Further TV Transmitters for Canada.

COMMERCIAL television broadcasting is rapidly going ahead in Canada, and Britain is benefiting by reason of the substantial orders for transmitting equipment which are being placed.

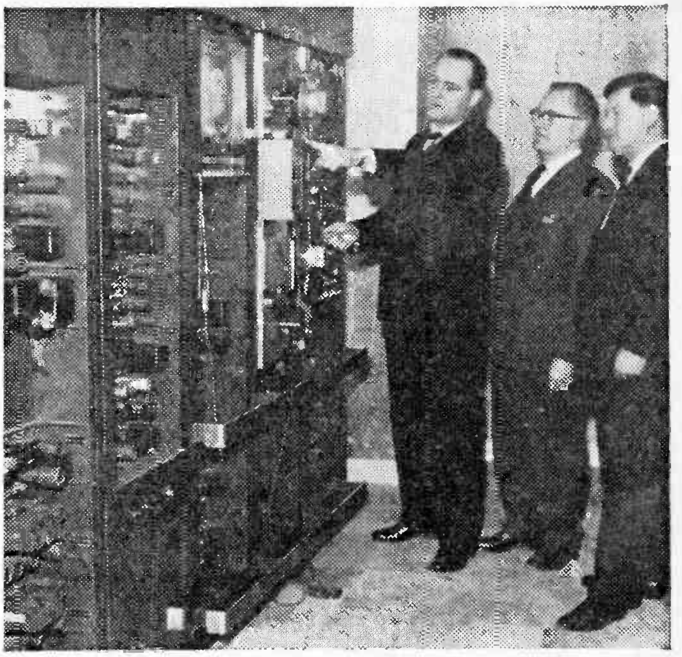
Following on the supply and installation of two commercial television stations in Montreal, which are now in operation, Marconi's have completed an installation in Ottawa — the first commercial television station in that city.

The Ottawa equipment includes a 4kW Band III vision transmitter type BD.366, an 18kW vision amplifier type BD.369, and a 9kW sound transmitter. A 12-stack column-mounted quadrant aerial and ancillary equipment have also been supplied.

An important technical feature of the amplifier is that special circuits are incorporated which absorb any reflected waves caused by extraordinary conditions (for example, the presence of snow and ice on the aerial system) which are causing a mismatch. Normally such a mismatch would result in the radiation of delayed signals, giving an unpleasant "ghosting" effect to the picture; this is not the case when the new amplifier is used. The "anti-ghost" circuits are the subject of Marconi patents and are exclusive.

Appointment

THE appointment of Dr. A. C. Robb, M.Eng., Ph.D., A.M.I.E.E., as Technical Manager, is announced by "Belling-Lee" Dr. Robb graduated at Liverpool University, and obtained a Master's Degree for post-graduate work. Subsequently he was awarded a Research Fellowship at Glasgow University to work on the design and commissioning of high voltage particle accelerators, and gained his Ph.D. for related studies. He has had considerable industrial experience in technical management in the fields of light engineering and instrumentation.



Mr. Bill Cheevers (left), Westward Television's Chief Engineer, points out features of Westward's new RCA tape machine to Mr. Baynham Honri, Technical General Manager (and Director), and Mr. G. L. Fosbrooke, Manager of RCA's Distributor Division.

New Italian TV Service

AN order has been placed by Radio Italiana Televisione (RAI) for a further seventeen Mark IV television cameras from Marconi's.

This order follows the successful introduction of the Marconi Mark IV camera in Italy last year when eight channels were delivered to RAI in time for the Olympic Games. It was chiefly through Marconi cameras that the Olympic Games were televised to all parts of the world.

The seventeen new channels now on order from Marconi's will be used to enlarge the existing facilities in RAI's Rome and Naples studios and will be put into operation in time for Italy's second television service scheduled to commence later this year.

New TV Station

THE BBC has placed a contract with Pudney and Son Ltd. of Colne Engaine, near Colchester, for the construction of the building for the new television station near Manningtree, Essex. This is one of several additional stations which the BBC is building to extend and improve the coverage of its television service.

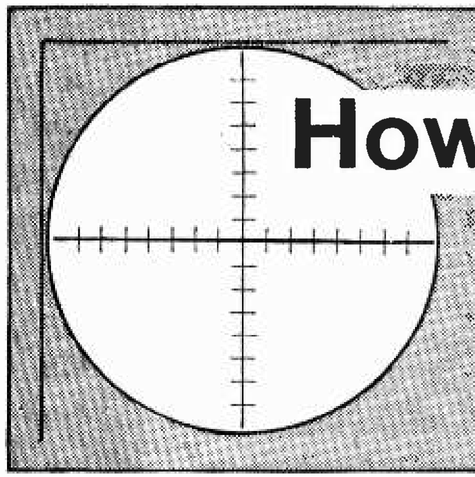
The Manningtree station will improve television reception for some 350.000 people in south-east Suffolk and north-east Essex, including those in Ipswich, Woodbridge, Felixstowe, Clacton-on-Sea, Colchester and Hadleigh.

As previously announced, a contract for the 500ft aerial mast for this station was placed in November 1960. The transmitting equipment is in course of manufacture and it is hoped that it will be delivered in time to allow the station to be completed during the summer of 1962.

No. 2—INVESTIGATING TV WAVEFORMS AND THE USE OF WOBBULATORS FOR EXAMINING THE RESPONSE CURVES OF TUNED CIRCUITS

(Continued from page 422 of the May issue)

By D. R. Bowman



AS explained earlier, the oscilloscope is a means of presenting visually, in a convenient manner, the relationship between two quantities—usually electrical quantities. Generally, one quantity is time or expressible in terms of time. Some points of servicing will now be discussed, not only to show how the oscilloscope is used but also to indicate the performance required. It will then be possible to lay down a reasonable specification for an oscilloscope for servicing.

Essentially, the oscilloscope consists, as has been seen, of a cathode ray tube and associated power supplies, a linear timebase generator for horizontal sweeping, and (if relatively small voltage and current waveforms are to be displayed usefully) a Y-amplifier. Considered for the moment as a " black box", it will have means of controlling the time-scale of the horizontal sweep, and input terminals to which the waveform to be examined may be fed. Ideally the Y-input will not appreciably load the circuit to which its terminals are connected.

Y-input Bandwidth

The severest conditions under which the oscilloscope will be used are those imposed by television servicing, or work with a similarly pulsed waveform. Fig. 3 should now be consulted.

Suppose it is required to ascertain whether the video amplifier is distorting line sync pulses, it must be possible to display the sync pulses without their being distorted in the oscilloscope. Since the voltage available at the video stage anode is about 30 or more, about 10V to 20V of sync pulse will be available. This might possibly be used to give Y-deflection directly, but in practice an amplification of two to three times would be needed.

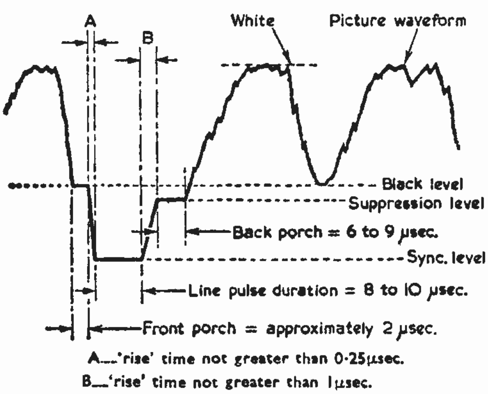


Fig. 3.—Part of a video waveform.

Y-amplifier Requirements

The Y-amplifier must therefore be able to supply the necessary output and gain, and must be able to pass a pulse of 0·25μsec width (the rise-time of the sync signal) without appreciable distortion. The bandwidth of the oscilloscope amplifier must therefore be equal to or larger than that of the video stage, namely, about 2 to 3Mc/s. This follows from the relationship

$$\text{Rise time in seconds} = \frac{0{\cdot}4}{\text{Bandwith}}$$

Putting in valves and rearranging:—

$$\text{Bandwidth in Mc/s} = \frac{0{\cdot}4}{0{\cdot}25 \times 10^{-6}\text{sec}}$$

The bandwidth of the Y-amplifier must necessarily include that of the circuits coupling it to the receiver video stage. Capacitance is the limiting factor in all cases, and it must therefore be ensured that neither the video stage output nor the Y-amplifier input contains more capacitance than absolutely necessary. Short connections, well spaced from any earthed objects, are therefore essential. Readers who already possess an oscilloscope may care to try the experiment of connecting up the 'scope to display a video waveform, and then clasp the connecting wire between finger and thumb of one hand. Usually a marked rounding-off of the displayed pulses results, except where circuit resistances are very low.

Synchronisation

In order to display such a waveform it will be found necessary to have some arrangement for steadying the trace. This involves using part of the signal to trigger the timebase generator, so that successive traces fall accurately upon each other and so appear to remain stationary. This will be touched upon later when design of the oscilloscope is described.

to use Oscilloscopes

Practical Examples

Another use of the oscilloscope is the investigation of the sync separator stage. For accurate interlace, it is essential that nearly all traces of line sync pulse be removed from the frame sync pulse. This is readily observed by connecting the Y-amplifier input to the frame oscillator sync electrode and observing the pulse. When investigating such "signal input" waveform it is usually necessary to render the line output stage inoperative, and this is best achieved not by removing "line drive" but by disconnecting the screen of the line output valve from H.T.+ and earthing it instead. This will reduce total H.T. current and the H.T. voltage may rise appreciably, so it will be advisable to "bleed off" the excess H.T. by connecting a 5k resistor between H.T.+ and earth. The component must of course have a suitable wattage rating. If the line output stage is allowed to function, pulses from the transformer and scan coils will appear readily in all circuits within a distance of a foot or more, owing to the very intense inductive field of these components.

Receiver timebase generators can be inspected with the aid of the oscilloscope by connecting the Y-input to the appropriate electrode of the valve or other component. Linearity can be judged, and corrective circuits can be checked for proper functioning.

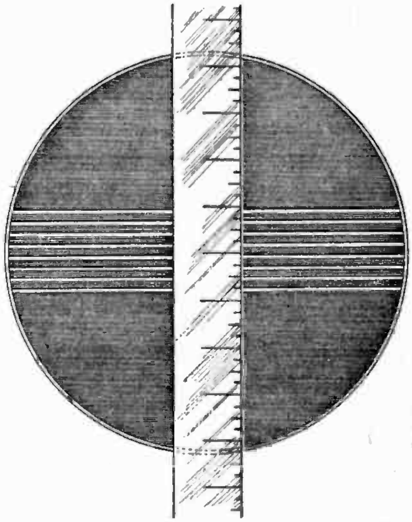


Fig. 4.—Calibration of an oscilloscope. A 6.3V heater supply is connected between earth and the Y-input terminals with the Y-amplifier adjusted to give a trace about 2in. in height. The sweep control is set to a high frequency and the mains frequency appears as a set of lines crossing the tube.

Calibration for Measurement

In such cases it is usually necessary to have some idea of the appropriate voltage being developed. This entails the calibration of the oscilloscope, and can be carried out as follows.

A 6·3V heater supply, carrying the heater current for which it was designed—usually one or more amps—is connected between the earth and Y-input terminals of the oscilloscope. The Y-amplifier is adjusted to give a trace of length about 2in. and the timebase generator ("sweep control") set to a high frequency. The mains 50c/s frequency will then appear as a set of lines crossing the tube, as in Fig. 4

If a Perspex graticule is provided on the tube face, the trace should be adjusted to fall accurately between known marks. Otherwise a flexible transparent ruler can be put over the tube face and the height of the trace adjusted to a suitable extent.

If the voltage is 6·3 r.m.s. the peak voltage—shown by the trace—is $2 \times 6{\cdot}3 \times \sqrt{2}$, or 17·8V. If the trace is adjusted to fill 1·78in., the calibration scale is $\frac{1}{10}$in. represents 1V—assuming the Y-amplifier is linear over this range. On a six-inch oscilloscope tube this may well be an unnecessarily small scale, and a larger can be used.

Once set, the Y-amplifier gain control should not be touched until the experiment has been completed. If the voltage of the waveform to be measured is sufficient to overload the Y-amplifier, it may well be possible to apply it direct to the deflecting plates. In such a case calibration can be carried out by using all or part of the 230V mains supply, remembering that the peak-to-peak value of a 230V supply is $2\sqrt{2}$ times the r.m.s. value.

Effect of Coupling Circuits

It is as well to keep in mind that in connecting to the Y-amplifier input it must be known whether the input terminal is a direct connection (D.C.), or whether a capacitive coupling is employed. Where a capacitor is used, for A.C. coupling only, a differentiating circuit exists which may distort the applied pulse (see Fig. 5). If the product

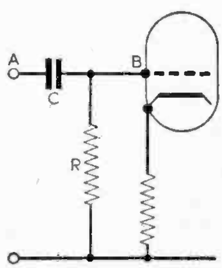


Fig. 5.—The capacitive input coupling to the Y-amplifier shown here results in a differentiating circuit which may distort the applied pulse.

CR is small compared with the input pulse width, differentiation takes place at illustrated in Fig. 6. This occurs because the capacitor C has time to charge or discharge between the arrival of successive pulses, and the actual voltage applied to the grid of the amplifier valve is very different from the actual input voltage.

To avoid this difficulty CR must be made large compared with the pulse width. If, for example, a 50c/s sawtooth waveform—such as is used for frame deflection—is to be viewed, CR should be proportioned according to the following analysis:—

1. Sawtooth repeats 50 times per sec, i.e. one sweep in 20msec.
2. Flyback is approximately $\frac{1}{10}$ sweep = $\frac{1}{500}$ sec or 2msec.
3. CR must be large compared with 20msec to show the sawtooth sweep correctly, and flyback will be even more accurately displayed.
4. R can hardly exceed 1M, since the valve (a high-slope pentode) may be damaged if a larger value is used.
5. For CR = 20msec:—

$$20 \times 10^{-3}\text{sec} = CR = C \times 10^{-6}$$
$$C = 20 \times 10^{-9}\text{F}$$
$$= 20 \times 10^{-3}\mu\text{F}$$
$$= 0{\cdot}02\mu\text{F}$$

6. CR must be large compared with 20msec, so take C = 50 times above valve = 1μF

Note that the above value is generously calculated; $0{\cdot}1\mu$F, however, would distort the wave discernibly. But, for lower frequencies, say down to 10 or 12c/s, 1μF would be barely adequate.

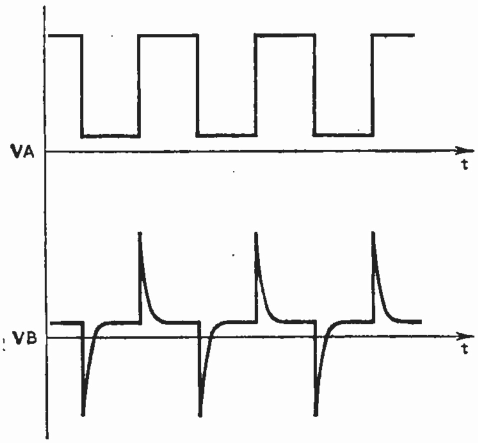


Fig. 6.—If the product C.R. in Fig. 5. is small compared with the input pulse width, differentiation takes place as illustrated above.

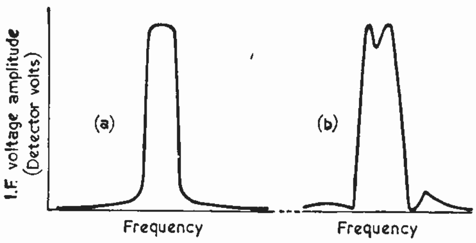


Fig. 7.—Two possible I.F. amplifier characteristics.

This means, of course, that the coupling capacitor is bulky and expensive if of high voltage rating, and it is therefore not advisable to connect the Y-input to a source of high peak potential such as exists across line scan coils. Frame scan coils are usually safe enough.

Where it is necessary to display line-scan, it is best to connect a small resistor in series with the scan coils and display the voltage across the resistor. One side of the resistor can usually be earthed, fortunately. A few inches of resistance wire, or a 6V motor headlamp bulb will usually serve as the resistor. Only a volt or so will be developed across the resistor on " scan ", but the flyback peak will be many times higher.

Audio Applications

Nothing has been said so far about audio waveforms. The display of these follows the same kind of pattern as the waveforms already discussed, and similar techniques and precautions are needed. It will now be profitable to turn to an examination of waveforms where the horizontal axis is not a temporal quantity.

Display of Non-temporal Quantities

The most important of these waveforms is perhaps the display of the response curve of a receiver, particularly the I.F. or overall radio-frequency response. Here the Y-axis is measured in voltage, as hitherto, but the horizontal X-axis is not time but frequency.

The reader will recognise in Fig. 7 (a) and (b) two possible I.F. amplifier characteristics. It is usually quite important to establish a particular I.F. response curve in the alignment of the I.F. amplifier of a receiver, and this is especially true in the case of F.M. and television receivers.

To produce such a display, it is necessary to replace the normal time scale of the X-axis by a frequency scale. This is possible if it can be arranged for the frequency input to the I.F. amplifier to vary linearly with time; then the time X-axis of the oscilloscope display, which is both normal and convenient, can, instead of time, represent frequency.

The Wobbulator

This artifice is in principle easy enough to arrange. All that is needed is for the timebase generator of the oscilloscope to control an oscillator so that as the sweep occurs, the frequency of a signal generator increases (or decreases) exactly in step. While the actual circuit arrangements of such a " wobbulator " may be—and usually are—quite complex, the principle is easy enough to comprehend.

The output from the I.F. amplifier used is at radio frequency, and it is not necessary to display the R.F. waveform itself as only the envelope of the wave is important. Consequently the best place to connect to the oscilloscope Y-amplifier input is the load resistor of the detector. Indeed, it may be enough to use an audio point (or take-off), though this is generally unwise for reasons which will appear shortly. Instability can readily be prevented by including—as near the detector as possible—a resistor of about 10k to 50k.

Effect of Selective Circuits

It is important in taking such measurements for the timebase generator to describe only a slow sweep, especially where selective circuits are concerned. If the sweep is too rapid, a good deal of distortion of the response curve may appear on the trace. This is because highly selective circuits have a considerable electrical inertia,

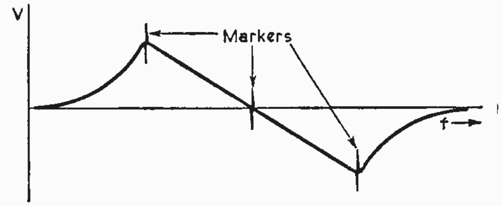


Fig. 8.—The discriminator characteristic of a VHF/F.M. receiver—the marker pips are at 80kc/s intervals.

causing voltages in these to build up rather slowly. If this seems strange, the reader should remember that the most selective circuits can cause severe high-note cut-off—in other words, the frequencies over about 3-4 kc/s disappear altogether. This effect, which used to be very marked in the old days when critical reaction was used in reception, is of course due to the same inability of selective circuits to cope with rapidly changing (high frequency) voltages. A sweep of 50 c/s is really too high; it is best to use a sweep of 10-18c/s, when all but crystal filters can deal with the low frequency involved. It will now be clear why an audio take-off point is not generally very useful as a source to receive response —the A.F. couplings usually cut off at a much higher frequency than 10-18c/s. One would be able to tell, of course, that a response curve existed, but its shape would be far from representing reality. The reader will recall that if one tunes rapidly through an unmodulated carrier a "plop" sounds in the loudspeaker. This "plop" is nearly of sine wave shape; it certainly is not a pair of sharp clicks such as would be a better representation of the steep sides of a good I.F. response curve.

In a television receiver it is possible to use a somewhat higher "wobbulating" frequency, and because the video amplifier has to have wide-band characteristics, a good take-off point is the CRT cathode. It is moreover readily accessible and connections to it seldom cause serious instability. However, the wider band of frequencies to be covered does cause problems in the "wobbulator".

For such response curves it is necessary to provide frequency markers on the horizontal scale. These may be omitted if comparisons only are required, but their provision enormously increases the usefulness of the display. Several different methods can be used. A popular and effective one is the use of a "ringing" circuit to show "pips" at definite frequency intervals. Brightness modulation of the electron beam of the oscilloscope gives instead of a continuous trace a series of dots spaced by definite frequency intervals. This is probably the more accurate method, provided proper precautions are taken in the circuit design. Alternatively, where a double-beam oscilloscope tube is used, a sinusoidal or pulsed trace of known freqency can be displayed by one beam while the other trace describes the waveform under investigation.

Discriminator Characteristics

In a VHF/F.M. receiver the discriminator characteristic can readily be shown (it will be like Fig. 8—the pips are markers at intervals of 80kc/s in frequency).

The best take-off point to obtain this trace is the discriminator audio take-off point.

Other Uses

The foregoing examples are only a fraction of the uses to which an oscilloscope can be put. Further examples, which there is no space to describe, include the detection of "parasitics" in an output stage, measurement of wave frequencies, phase companions and measurements, investigation of noise levels, measurement of the Q of components, use as a resonance detector and as a null point detector in bridge measurements, detection and measurement of intermodulation and harmonic distortion in audio and video stages, to say nothing of the "face generator" displayed by the Royal Air Force at last year's Radio Show. The final article will deal with the design of a simple oscilloscope, and it will be shown how to add to it as time and funds permit to produce an advanced instrument capable of assisting materially in development work.

(To be continued)

WIDER VIEWING AREA IN SCOTLAND

The Independent Television Authority has placed an order with Pye Telecommunications Limited of Cambridge, for the supply and installation of a television re-transmission link in North East Scotland.

The Authority is setting up new television broadcasting stations, to cover the area, at Durris in Kincardineshire and at Mounteagle in Ross and Cromarty. Durris will eventually receive programmes by Post Office Link, but this will not be available for some months after the opening of the Mounteagle station. The Postmaster General has therefore authorised the use of this re-transmission link between Durris and Mounteagle.

The broadcast programmes from Durris will be picked up by VHF receivers at Pikey Hill, a high site near Elgin. From these receivers the programmes will be re-transmitted by Pye Microwave equipment, working in the 7000Mc/s band, to Mounteagle—a distance of 36 miles.

Pye Telecommunications Ltd. will supply and instal all of the equipment for the link. The microwave transmitters and receivers will be type PTC M1000G, which is designed for monochrome or colour television signals, with accompanying sound, using any of the standard systems—405, 525, or 625 lines.

Flywheel Synchronisation

Part 3

By R. Talks

COMMERCIAL CIRCUIT 2

THIS circuit is shown in Fig. 13. It has the advantage, for home construction, of not requiring a discriminator transformer. The discriminator, in fact, is not a balanced type as in the previous circuit. That is to say, its output does not range symmetrically above and below zero; zero is one limit of its output. Before we embark on a study of this type of discriminator, let us clear up the rest of the circuit.

Circuit Description

Here, V1 does the job of both sync separator and phase discriminator. The remainder of the circuit is very much as before. The oscillator circuit is somewhat simplified; R18 limits grid current and thereby increases the grid conduction period because the grid current, being limited, has to flow for a longer period to replace the charge on C9. As before, R17 is taken to a point which is near to H.T.+ for most of the cycle. The anode is chosen, rather than H.T.+ itself, because the latter connection gives heavy grid current damping before oscillation starts and can prevent its starting altogether. When the circuit is not oscillating, the pentode anode conducts and the anode voltage is very low, only 10 or so. Thus, grid damping is considerably reduced by returning R17 to the anode and there is no difficulty with self-starting. In case it should be asked why there is no condenser here to increase the rate of fall of the drive waveform, it must be revealed that for purely practical reasons (such as limited plug and socket connections on the line transformer) the only suitable place to derive the feedback is g2 of the line output valve. Unfortunately, due to ringing on the waveform here, the pentode is brought on again, slightly, via the pentode of V2 during flyback, thus reducing EHT! The oscillator coil consists of 740 turns (S1) and 2,265 turns (S2) of 42s.w.g. S.S.C. wire, other details being as before.

The reactance valve here must reduce oscillator frequency as its grid is raised in potential. To obtain the correct phase quadrature component conveniently, we must feed the phase shift network from the oscillator grid. In any case, the screen

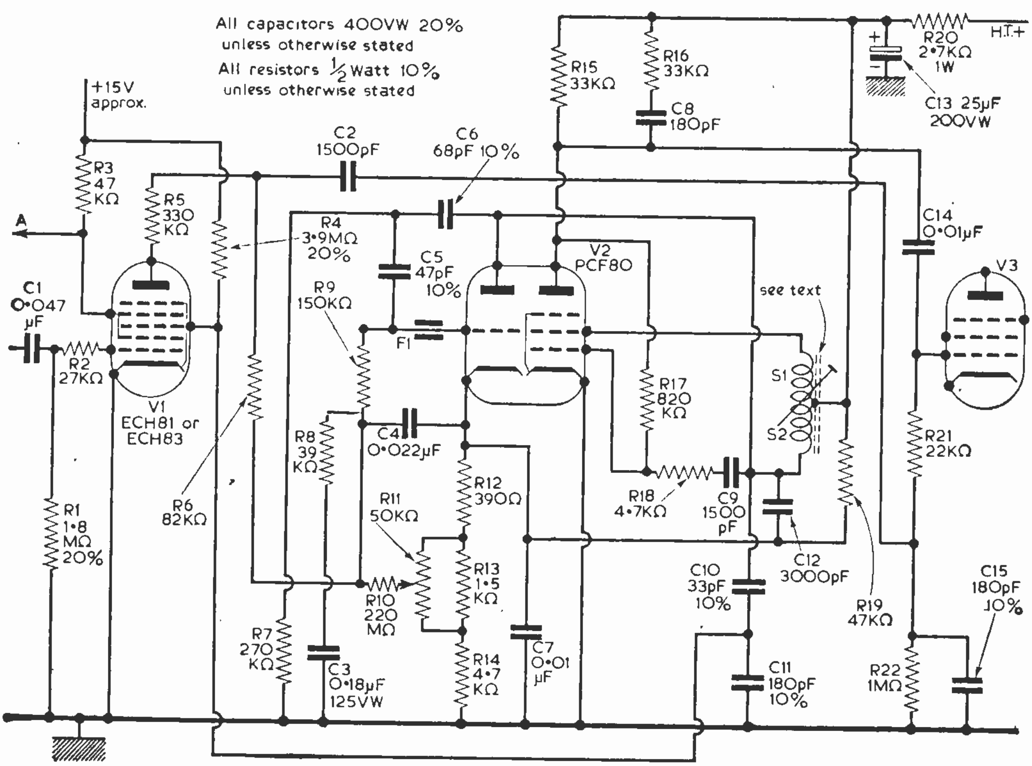


Fig. 13.—A commercial circuit in which a discriminator transformer is not used.

grid is not suitable because S1 is only a coupling coil, not part of the tuned circuit, and the g2 voltage is by no means a sine wave. To obtain the antiphase component now, we need more than 90° phase shift which requires a two-stage RC network. The components are C6R7, C5R9. The reactance valve receives its bias from two sources. There is an adjustable bias derived from H.T.+ via R19, R12, R13 and R14. This is set by R11, which is the line hold control. It is added via R10 to the control voltage arriving via R6. This latter resistor, with C4, forms the flywheel filter, whilst R8 and C3 are the damping circuit. F1 is a Ferroxcube bead grid stopper to suppress a high frequency parasitic oscillation—a 47Ω resistor should serve equally well.

Discriminator Action

It is now time to consider the discriminator, and it is as well to study the principle first. For the moment, consider that the heptode has a small positive voltage on g2 and g4 and zero voltage on g3 so that the anode can draw current when g1 permits. Normal sync separation is carried out on g1, so that the valve can only conduct on the tips of the sync pulses. The anode is supplied with the timebase waveform via a condenser C (see Fig. 14a). R1 supplies some steady positive voltage to keep the anode above zero throughout the whole waveform. R2 is a high resistance. When a sync pulse brings g1 up to zero voltage, the anode draws current and, because R2 is high, the anode voltage falls below the knee, in fact practically to zero. The anode current is equal to the voltage at S divided by R2 and so is dependent upon the position of the sync pulse relative to the timebase waveform. The anode current is drawn via C, which becomes charged, the amount of charge being determined by the average anode current over the conduction (i.e. sync pulse) period. So the average voltage at S varies with the relative phase of the waveforms. It is only the small variations in what is a relatively large voltage that interest us, but this is no different

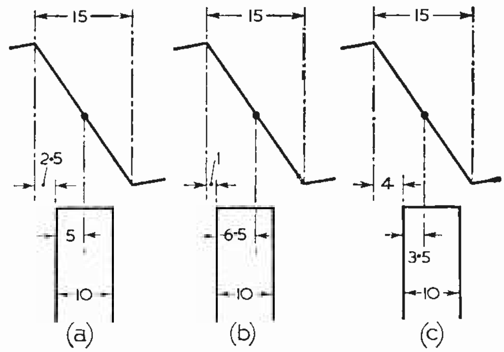


Fig. 15.—The positions of the sync pulses at the centre (a) and each end (b) and (c) of the pull-in range.

from taking the output from our, earlier, balanced discriminator and adding a steady voltage to it. With suitable arrangements to provide the reactance valve with correct bias, then we have so far no difference from the behaviour discussed earlier. As we have just seen, the average anode current determines the charge acquired by C, and this in turn depends upon the average voltage of the timebase waveform over the sync-pulse period. Thus, sync pulses falling outside the PON region give the same result as pulses symmetrically situated around O. Pull-in will therefore occur at points also symmetrically situated with respect to O. In practice, the timebase waveform shown is hard to produce and the sawtooth of Fig. 14c takes its place. A sawtooth is easily derived from the drive waveform and this, in principle, is how the discriminator of Fig. 13 works. In point of fact, a non-linear sawtooth is used to overcome the centring problem which must be discussed next.

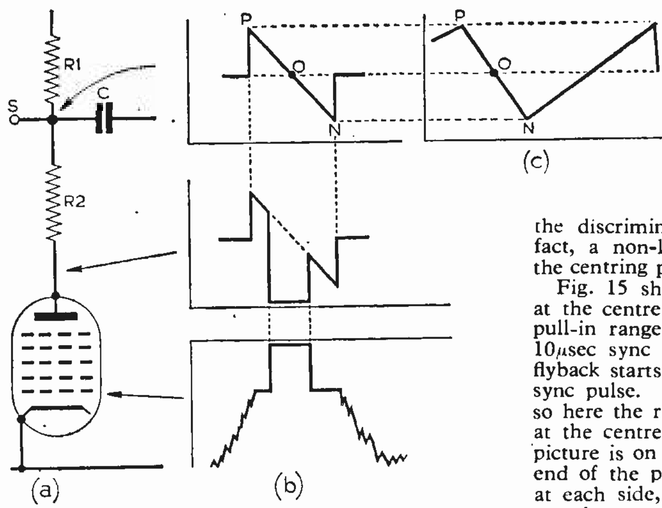


Fig. 14.—(a) The circuit of V1 in Fig. 13, for purposes of analysis.

(b) The desired timebase waveform.

(c) The sawtooth waveform derived from the drive waveform.

Fig. 15 shows the positions of the sync pulses at the centre (a) and each end (b) and (c) of the pull-in range. Here we take 15μsec flyback and 10μsec sync pulses. At the minimum (Fig. 15b), flyback starts 1μsec before the leading edge of the sync pulse. The front porch is 1·5 to 2μsec long, so here the right-hand side is not folded over, but at the centre of the pull-in range 0·5 to 1μsec of picture is on the flyback. Ideally, we require each end of the pull-in range to produce equal folding at each side, then the centre of the pull-in range exactly centres the picture within the raster. In any case, the centre of the pull-in range should not produce folding. We can achieve this if we raise the discriminator current, when the timebase is out of sync, above the level corresponding to in-sync at O (Fig. 15a). This is achieved by using a non-linear sawtooth. The level of this is somewhat higher, at O' (see Fig. 16a). Now, when the timebase runs well out of sync, the sync pulses quickly pass through the whole waveform. The control voltage then corresponds to the average level of the whole waveform, i.e. O'. As the

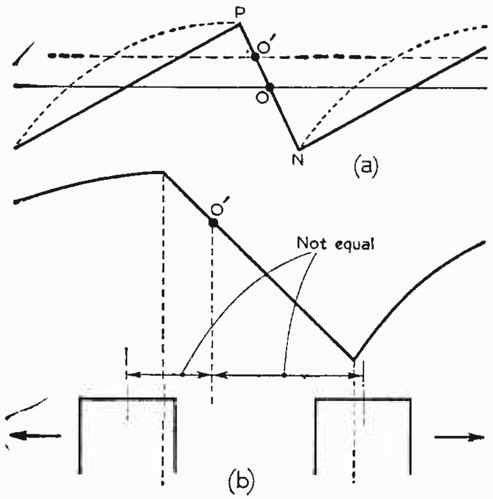


Fig. 16.—When a curved sawtooth is used, O is the centre of the pull-in-range, but not of the hold range.

oscillator frequency is brought towards sync, control voltages build up, one way or the other, from this level. PO'N remains reasonably linear, so O' is the centre of the pull-in range. The only difficulty introduced by this curved sawtooth is that O' is not the centre of the hold range still. This in itself is not important, but it gives a poor feel to the line hold control and can give rise to confusion when trying to set it to the centre of the pull-in range. The ends of the hold range are shown in Fig. 16b somewhat exaggeratedly. They are the positions where the charge passing through the discriminator reaches extreme values. Pulses passing outwards through these points, as shown by the arrows, reverse the direction of change of discriminator output. The hold range is simply recentred by allowing the bottom part of the curved sawtooth to fall below zero. The point where it reaches zero is one end of the hold range (see Fig. 17). This is the actual arrangement of Fig. 13. Here the drive waveform is integrated via R21 and C15; R22 is high and merely provides a D.C. path between grid and cathode of the line output valve. Change of C15 changes the curvature of the sawtooth and so the picture centring. It also changes the slope of PO'N and with it the pull-in range. R12 and R13 set the operating bias range of the reactance valve. R14 sets the D.C. level of the sawtooth.

Effects of Frame Sync Pulses

The only remaining problem is that of the frame sync pulses. Normally, they would increase the conduction time of the discriminator. It would conduct everywhere where g1 is at zero and the sawtooth above zero. This would, of course, change the discriminator output. (The result of this is easily seen by shorting g3 to earth!) This is prevented by controlling the anode current not only from g1 but also from g3. A gating sine wave is applied here. It is derived, via a capacitive potentiometer C10 and C11 (to prevent phase shift), from the grid of the oscillator. So, its positive peak always comes at the middle of the falling portion of the sawtooth. When the valve conducts, g3 draws grid current which charges C10 and C11. When the timebase is in sync, then g3 is at zero at the tip of each sync pulse but at a short distance each side of the sync pulse it is negative and cuts off anode current regardless of the voltage on g1. Thus, it allows the frame pulses to increase the conduction period only a small amount, and the resulting curvature recovers during the remainder of the frame blanking, leaving only a small residual amount at the top of the picture. The waveforms are shown in Fig. 18. This gating at g3 also renders the discriminator immune to spurious signals except those very near to the sync pulse itself. However, it does raise a problem with out-of-sync behaviour.

Out-of-Sync Behaviour

Suppose, due to interference, the timebase becomes out of sync and that the time constant of the g3 circuit is long. Then the g3 waveform remains much the same for many lines, i.e. its tip just comes up to zero. Now the discriminator does not conduct at all, because sync pulses do not coincide with the g3 conduction period. The oscillator therefore drifts further and further out of sync. Eventually the bias on g3 would leak away and conduction of the discriminator become possible again, but, at the best, g3 could only permit conduction over slightly more than the positive half-cycle of the sine wave and pull-in behaviour would, to say the least, be adversely affected. These defects are overcome in two ways. First, the g3 time constant is short—only a few

(Continued on page 487)

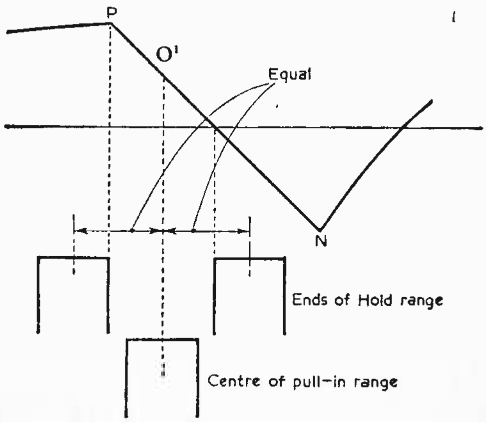


Fig. 17.—The hold range is recentered by allowing the bottom part of the curved sawtooth to fall below zero.

The Colour Code

READING RESISTOR VALUES

THERE are two general methods of indicating the value and tolerance of resistors, apart, of course, from direct printing on the component. The first, and more general method, is to use a system of coloured bands where the first band indicates the first figure, the second the second figure, the third band the multiplier and the fourth the tolerance.

Black represents zero, brown one, red two, and so on (see Fig. 1). The recognition of resistor values by one quick glance is not such a difficult operation as the table may at first sight suggest. A little practice with a few resistors taken at random from a box is far better than prolonged study of the table, and once learned from practical handling, the system sticks in the mind and there is no conscious working out involved. For example, if a resistor is selected which has a third band coloured green, one immediately knows that the value is in megohms, and if the third band is yellow, the value is in hundreds of thousands; orange, tens of thousands; red, thousands; and brown, hundreds.

The first and second bands denote the precise value. As a practical example, the bias resistor in the cathode circuit of a valve may be orange, orange, brown, which denotes 3-orange, 3-orange, one nought-brown, or 330Ω (Ω=ohm, kΩ=kilo ohms or thausand ohms, MΩ=megohm or million ohms). Another common value for a bias resistor is *brown, green, brown*, or 150Ω.

Where the third band is black this is not to be counted at all (no noughts). For example, a feedback resistor may be coloured yellow, violet, black =47Ω (only the first two bands have significance). Values of less than 10Ω are not often encountered but are denoted by a black band, a coloured band to denote the value followed by another black band. If the second band were *green* the value would therefore be 5Ω. Where the second band is black this denotes 0, which is added to the first band. For example, a resistor of 50Ω would be coloured *green* (5), *black* (0) (no noughts).

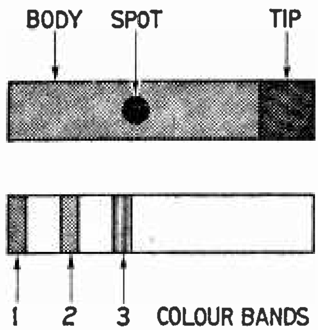
Further frequently met values are 470,000Ω (470k), *yellow, violet, yellow;* 1,000,000Ω (1M), *brown, black, green;* 820,000k (820k), *grey, red, yellow;* 2·2M, *red, red, green.*

When a fourth band follows the third this represents tolerance. This means that the actual value will be within certain limits of that stated by the coloured bands. For example, a "100k" resistor with a silver band might, in fact have any value from 90k (−10per cent) to 110k (+10per cent). Where there is no fourth band, the tolerance is plus or minus 20per cent. A *silver* band indicates a tolerance of 10per cent, *gold* 5per cent. Close tolerance resistors are denoted by a fourth band of *brown*, 1per cent, or *red*, 2per cent. Tolerance should not be confused with stability, which means the desirable property of maintaining the stated value over varying conditions (temperature, etc.). High stability resistors are marked with a fifth band of *salmon pink*, or the background body colour may be *salmon pink*.

The other general method of colour coding resistors is by marking the body with the first significant colour, the tip with the second, a spot or band on the body denoting the number of noughts. For example, a 47,000Ω (47k) resistor would have a main body colour of *yellow* (4), a tip of *violet* (7) and a spot on the body of *orange* (three noughts). The tolerance is marked on the other tip, and as this is usually *gold* or *silver* (if any at all) no confusion is caused as a rule. ■

RESISTOR COLOUR CODE—Fig. 1

0. Black	5. Green
1. Brown	6. Blue
2. Red	7. Mauve
3. Orange	8. Grey
4. Yellow	9. White

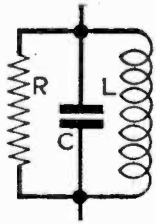


First Number—Body or Band 1 } Yellow =4
Second Number—Tip or Band 2 } Mauve = 7 } 47,000Ω (47k)
Number o Noughts—Spot or Band 3 } Orange= 3

A Brown Band at the extreme end indicates ±1% tolerance.
A Red Band at the extreme end indicates ±2% tolerance.
A Gold Band at the extreme end indicates ±5% tolerance.
A Silver Band at the extreme end indicates ±10% tolerance.
No Band at the extreme end indicates ±20% tolerance.
A Salmon Band indicates high stability.

TUNED CIRCUITS

By K. Royal



THE tuned circuit, representing the very foundation of all radio and television receivers, merits a practical analysis. In its simplest form it comprises inductance L and capacitance C, with resistance R contributed primarily by the resistance of the wire making up the inductance. A series-tuned circuit revealing these elements is shown in Fig. 1.

Reactance

Both inductance and capacitance behave in A.C. and signal-frequency circuits rather like resistance behaves in D.C. circuits. That is, they resist the flow of current. In a resistive circuit, this, of course, is called resistance, but in inductive and capacitive circuits the effect is called reactance, denoted by the capital letter X. The inclusion of a miniature L or C at the base of the X, such as X_L or X_C signifies inductive reactance and capacitive reactance respectively.

Reactance, like resistance, is measured in ohms, and depends upon the frequency of the applied signal.

$$X_L = 2\pi fL$$

where f is the frequency of the signal in cycles per second (c/s) and L the inductance in Henrys.

$$X_C = 10^6/2\pi fC$$

where C is the capacitance in microfarads.

The signal voltage applied to the tuned circuit in Fig. 1 is denoted Es, and the signal current by I. From Ohm's law, the voltage E_R developed across R is simply I × R, and similarly the voltage E_L developed across L is I × X_L and voltage E_C developed across C is I × X_C.

Although $E_R + E_L + E_C$ must equal Es, the waveforms of these three voltages do not occur exactly in step with each other. The voltage waveform across C is always 90° behind that across R, while the voltage waveform across L is always 90° in front of that across R, as shown diagrammatically in Fig. 2. This means, then, that the voltage waveform across either L or C is 180° out of step with the voltage waveform across the opposite reactive element.

Resonance

Now, when the voltage across both L and C is equal, such as when $X_L = X_C$, it follows that E_L will exactly cancel out E_C. This, in fact, happens, and the condition is called resonance (e.g. $X_L = X_C$, from which can be derived $f_0 = 10^6/2\pi\sqrt{(LC)}$, where f_0 is the resonant frequency in kc/s, L the inductance in μH, and C the capacitance in pF). Thus, at resonance, E_R is equal to Es, and if R is purposely arranged to be small, which it often is, then the current I is limited only by that value (e.g. I = Es/R).

Looking at only one reactive element at resonance—say the inductance—by substituting Es/R for term I in the formula $E_L = I \times X_L$ is obtained a new formula, which is

$$E_L = E_S \times 2\pi fL/R$$

By applying some typical values, such as f = 2Mc/s, L = 60μH, and R = 5Ω, is obtained $E_L = 2\pi \times 2 \times 10^6 \times 60 \times 10^6 \times E_S/R$, which works out to $E_L = E_S \times 150$ approximately.

This mathematics proves beyond any doubt that the signal voltage developed across the inductance at resonance is approximately 150 times greater than the signal voltage actually applied to the tuned circuit! The same exercise can be applied to the voltage developed across the capacitance at resonance, with similar results.

Magnification Factor or Q

The ratio E_L/E_S corresponds to the magnification factor or Q of the tuned circuit. The greater the Q value, symbolising ' quality ', the greater the magnification factor or voltage step up between that applied to the circuit and that developed across the inductance or capacitance. Q is thus equal to $2\pi fL/R$, and will be highest when L is highest and R is lowest.

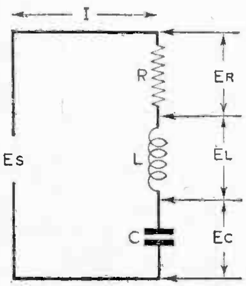


Fig. 1 (above).—The basic elements of a tuned circuit: R is the equivalent series resistance of the tuned circuit which takes into account the skin effect of the coil wire at radio frequencies.

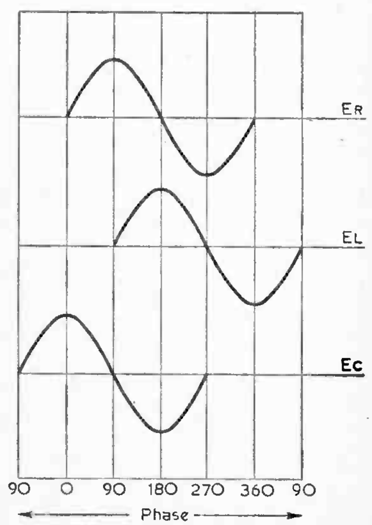


Fig. 2. (right)—The voltages developed across R, L and C do not occur exactly in step with each other—as shown. The voltages across L and C are 180° out of step with each other, and each 90° out of step with the voltage developed across R.

In most tuned circuits the inductance is fixed and the capacitance is variable, thereby permitting the resonant frequency to be adjusted over the required operating band. If the voltage across the inductance is plotted against frequency in proximity to the resonant frequency, a typical response curve of a tuned circuit will be obtained, as shown in Fig. 3. At the resonant frequency the voltage is at maximum and drops either side of the resonant point. The rate at which the curve falls is a measure of the selectivity of the tuned circuit, and a high degree of selectivity is often required to prevent a station slightly removed in frequency from that to which the circuit is tuned from causing interference to the wanted station.

In other words, the tuned circuit should only accept the required signal and reject or severely attenuate other signals of slightly displaced frequency. In order to do this where there are a large number of stations operating very close together, such as on the medium waveband after dark, the overall response curve of the receiver is required to be very sharp indeed—the receiver should have good selectivity. There is, of course, a limit as to how sharp such a curve can be made on commercial sets, and, because of the small spacing between certain stations, it is often impossible to separate them on an ordinary amplitude-modulated receiver. If the curve is made too sharp, it tends to suppress some of the sidebands of the required signal and as a consequence attenuate the higher audio frequencies of the transmission. Nevertheless, it is sometimes better for this to happen than receive persistent background interference on the required programme.

Q can also be used as a measure of selectivity, and it can be defined in terms of selectivity or bandwidth. Referring again to the response curve in Fig. 3, the bandwidth is defined as those frequencies (f2 − f1), which correspond to points either side of resonance where the signal voltage is 0·707 of the maximum value. These points are sometimes called 'half power points'. It can be shown that Q is approximately equal to $f_0/(f2 - f1)$. Thus, if f_0 is 2Mc/s and (f2 − f1) is 20kc/s, then Q = 2,000,000/20,000, which is equal to 100. Similarly, the bandwidth (f2 − f1) of any tuned circuit with a known Q can be found from f_0/Q.

Two major points have thus evolved from this discussion of Q: one is that the higher the Q the higher the gain or output voltage from a reactive element in the tuned circuit, and the other is the higher the Q, the greater the selectivity and discrimination against adjacent stations. Further, high values of Q can be obtained by keeping the resistance of the inductance as low as possible. In the early days of crystal receivers, high Q coils were obtained by the use of relatively large diameter wire wound on formers of 3in. or greater diameter. The modern trend is to use less wire (and thus obtain a smaller resistance) whilst providing the required inductance value by low-loss dust-iron or ferrite cores.

It should be mentioned that the factor R is the equivalent series resistance of the tuned circuit which takes into account the skin effect of the wire at radio frequencies. R.F. currents in a coil tend to flow nearer the outside surface of the wire as the frequency is raised, which, in effect, increases the resistance with increase in frequency, since the area through which the current flows is reduced. This factor, therefore, causes the Q to fall with increase in frequency. But, on the other hand, it has been shown that the Q rises as the frequency is increased ($Q = 2\pi fL/R$), and the total effect is that the Q remains substantially constant over a given frequency band.

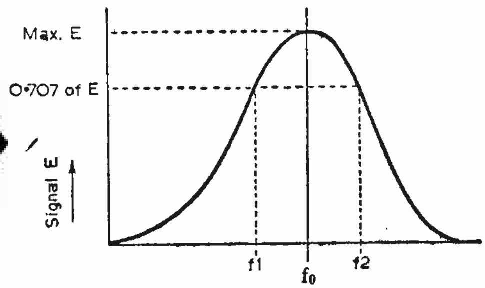


Fig. 3.—A typical response curve of a tuned circuit, showing the half power points and the bandwidth.

The Tuning Capacitor

The tuning capacitor itself also has an R loss, but this is usually very small these days, and most capacitors used for R.F. circuits can be classified as being high-Q. The effective Q of a capacitor is equal to $1/2\pi fCR$, where R is the dielectric loss.

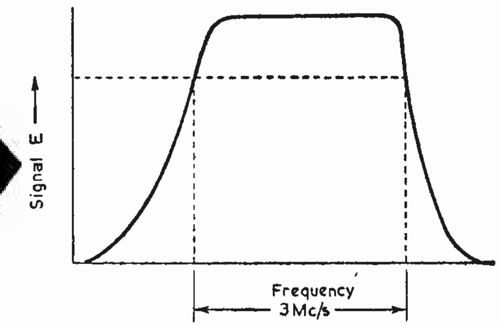


Fig. 4.—In television tuned circuits, a large bandwidth is required to accommodate the sidebands of the high video frequencies. This is accomplished by the use of staggered tuned circuits and by resistive damping.

The signal voltage developed across the capacitor at resonance, as has been shown, is of equal amplitude to that developed across the inductance, but of opposite phase. Thus, the coupling from the tuned circuit can either be from the inductance or from the capacitance, and, in both cases, the magnification of the circuit is obtained.

However, when a tuned circuit is connected to other circuits, such as a valve anode, grid, diode or to an aerial, via a coupling capacitor or coil, the tuned circuit is loaded by the external circuit and the effective Q is reduced. The external loading can, in effect, be considered as an increase in the value of R. It is for this reason that the loading on tuned circuits must be kept as small as possible if the selectivity is to be preserved.

This effect has been noticed by most experimenters and service technicians when, for the purpose of a test, the aerial has been removed from the normal aerial socket and connected direct

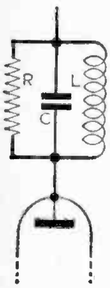


Fig. 5.—Damping is applied to a tuned circuit (by adding resistor R) to reduce the Q and increase the bandwidth.

to the control grid of the first valve to which the tuning coil is connected. This action may have increased the strength of the signals, but it has more than likely resulted in several signals being picked up at the same point on the tuning dial simultaneously.

The same often applies when an external aerial is connected to a portable receiver. If the aerial is extra long, then the aerial tuned circuit or ferrite aerial is loaded heavily by the R losses in the aerial, and the selectivity is considerably impaired. Coupling such an aerial through a small value capacitor reduces the loading and restores selectivity.

On an average receiver, of course, there are several tuned circuits, and the effect of these enhances the overall selectivity, so damping just one circuit may not detract too much from the total selectivity. However, in a simple diode receiver. such as a crystal set, where only one tuned circuit is employed, heavy damping owing to too close an aerial coupling or low-Q circuit will result in the local station being received almost over the entire tuning range.

On television receivers, especially in the vision I.F. stages, the selectivity must not be too sharp, since a 3Mc/s bandwidth is necessary to allow the higher frequency vision signal sidebands to pass through the receiver without attenuation. Stagger-tuned circuits are generally adopted, so that the resultant effect is a response curve with a flat top and steep sides, as shown in Fig. 4. In some cases, the required bandwidth can only be achieved by damping the tuned circuit with a resistor, as shown in Fig. 5, to reduce the effective Q.

Positive feedback or so-called reaction has the effect of increasing the Q of a tuned circuit, and this artifice was employed quite extensively in the early days of radio. The tuned circuit was connected to the grid of the valve and some of the signal was picked up from the anode and fed back to the grid via a small coupling winding on the coil. Too great a coupling, of course, makes the stage into an oscillator, but if the feedback coupling is adjusted to be just below the point giving oscillation, a negative resistance is reflected across the tuned circuit which cancels the positive resistance R. This arrangement is sometimes known as Q-multiplication. ■

Comprehensive Television Installation

Thirteen Marconi closed-circuit television camera channels and associated equipment form an integral part of a new automatic routing system, to facilitate the inspection of new car bodies at the Standard-Triumph Motor Company's Works at Coventry. The installation is claimed by Standard-Triumph to be unique and the most advanced in the world in terms of efficiency and rigidity of control.

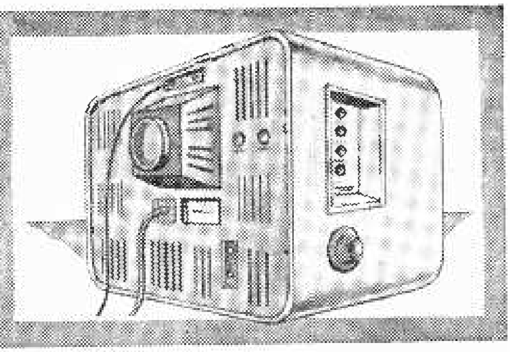
The cars arrive on conveyor belts from the manufacturing areas into a new extension hall for further inspection. Each of the various types of vehicle is carried in a special skip which incorporates trip devices peculiar to the type it is intended to carry. These trips actuate routing mechanisms on the conveyor belt system to channel the vehicles to their correct destinations in the area quite automatically. Here they undergo a series of stringent inspections after which the "passes" are automatically delivered to other floors while any rejects are diverted along a rectification line for further work to be done on them.

The closed circuit television installation fulfils several functions in the routing and inspection processes, and for these the cameras are installed at strategic points within the area. At a central Control Room five Marconi 14in. monitors provide pictures from five cameras mounted in various parts of the body storage area to enable controllers to identify the various types of car bodies passing along the conveyor belts and to keep the Programming Department constantly informed of the current position. Details of the colour and other relevant data are carried in code form on a card on each vehicle.

Any of the remaining eight cameras can be switched to the sixth picture monitor and this enables a controller to keep a close watch on the passage of vehicles at all stages of progress. He can ensure that no mishap occurs; he can check that the cars are moving along their programmed routes; he can foresee where bottlenecks are likely to occur and take steps to avoid them, and generally expedite the progress through the inspection area. The use of television thus enables all this supervision to be carried out from a central point and removes the necessity for a man to be stationed at every point equipped with an open telephone line to the Programme Dept.

The Marconi installation consists of thirteen camera channels Type BD871 and eight 14in. picture monitors Type BD879, together with ancillary equipment. The thirteen control units which form part of the camera channels are contained in a single rack-mounting unit with an oscilloscope for monitoring purposes.

Servicing Television Receivers



No. 68—THE DECCA DM45

By L. Lawry-Johns

(Continued from page 408 of the May issue)

THE fault of sound on vision may be due to changes in alignment in the tuner and, last month, details were given for adjusting the core of the oscillator. However, if the sound on vision is severe and there is also evidence of vision on sound (a buzz which varies with the picture content), check C87 and C86. If the buzz is accompanied by background hum which is constant, check C85.

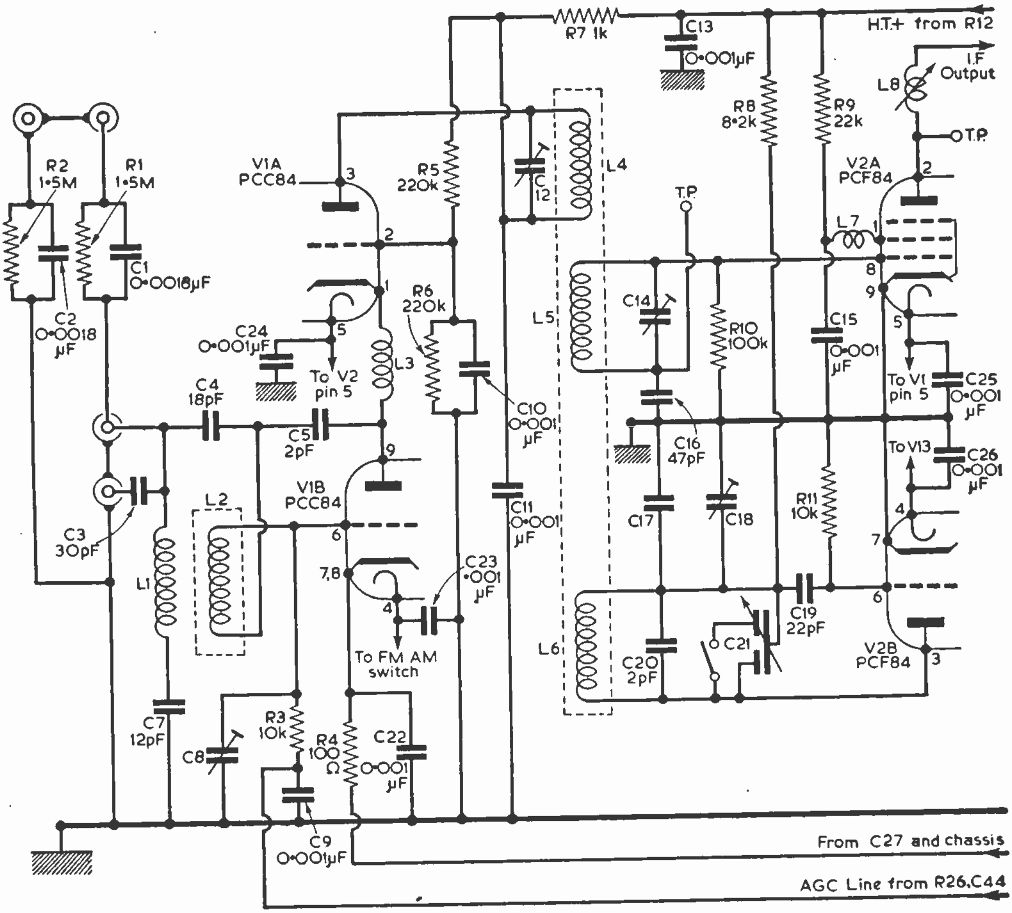


Fig. 9.—The circuit of the Cyldon tuner used in some models.

A 32μF capacitor (350VW) with leads terminating in crocodile clips is always a handy accessory for bridging suspect capacitors. When dealing with smaller decoupling capacitors in R.F. and I.F. circuits, test leads are of no use, since the connections must be kept short and direct, but for smoothing and low frequency circuits, leads of a few inches are not likely to introduce instability. Capacitors should never, however, be strapped in odd positions of convenience and left, since although this may clear the fault on the receiver in question, radiation can be set up, giving rise to severe patterning on neighbouring receivers and thus cause quite a little trouble in the immediate locality. Correct replacement, even if inconvenient at times, is always worthwhile.

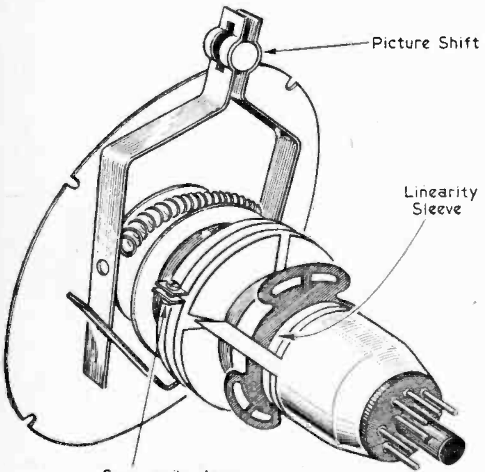


Fig. 10.—The positions of the linearity sleeve and picture shift control.

Use of Controls

VR1. R.F. Gain Control

Its purpose is to prevent overloading of the R.F. stage which would give rise to sound-on-vision and vision-on-sound effects. The correct setting is that which provides a strong smooth picture without the above effects occurring and with the contrast set mid-way.

VR2. Contrast

This is set to provide a correctly "toned" picture in conjunction with the brilliance control. By "toned" is meant the rendering of blacks, whites and greys (the latter all too often being absent). For example, the lapels and pockets should be discernible even on a dark suit and this is the sort of thing which should be looked for if a receiver cannot be set up on Test card C.

If the contrast is turned down too far the picture will appear "thin" and pale with no blacks resolved. The contrast varies the strength of the signal mainly in the V3 stage.

VR3. Brilliance

The brilliance control should be set with the contrast to produce the most pleasing picture in respect of room lighting. It varies the operating level of the tube emission.

VR4. Interlace

The interlace control has already been referred to briefly. It is initially factory-set and should not require adjustment over considerable periods. It is situated just below the mains panel. To set this correctly, turn it fully anti-clockwise (minimum resistance) and also turn the hold control (VR6) anti-clockwise.

Rotate the interlace control to lock the picture, if necessary adjusting the hold control to allow this to be achieved. Reset both slightly to provide good interlace over the whole locking range of the hold control (which should be approximately a quarter of a turn).

VR5. Volume Control

VR6. Frame Hold

Incorrect setting will result in the picture rolling downwards or slipping upwards: jumping would perhaps be a better term. The picture should remain locked when switching from one channel to another.

VR7. Frame Height

This controls the vertical size of the picture and should be set so that the edge or border of the test card is out of sight to allow for variations owing to mains voltage fluctuation and temperature rise.

VR8. Frame Form

This affects the top of the picture only and is adjusted to bring the top scanning lines into uniform spacing with the remainder, i.e., if the top is extended or compressed adjust this control.

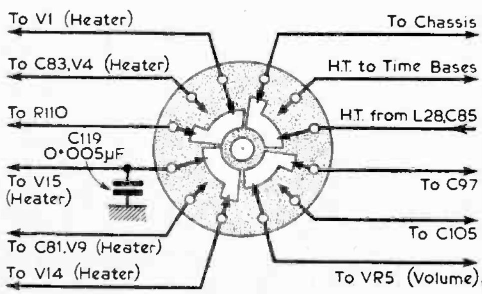


Fig. 11.—The H.T. and heater switching.

VR9. Frame Linearity

This adjusts the overall spacing of the scanning lines so that the bottom is not extended or compressed with respect to the centre. It also affects spacing over part of the upper scan.

VR10. Spot or Interference Limiter

This is provided to minimise the brilliant spots or streaks caused by interference. If wrongly adjusted it will attenuate the normal white content and produce a flat and lifeless picture.

(Continued on page 474)

Letters to the Editor

The Editor does not necessarily agree with the opinions expressed by his correspondents.

SPECIAL NOTE: Will readers please note that we are unable to supply Service Sheets or Circuits of ex-Government apparatus, or of proprietary makes of commercial receivers. We regret that we are also unable to publish letters from readers seeking a source of supply of such apparatus.

VALVE TESTING FOR BEGINNERS

SIR,—Many thanks to Mr. H. Peters for his simple but worthwhile valve tester in the October issue. I have found it to be a very good aid to TV testing.

I must, however, draw attention to a mistake in the valveholder connection data: base No. 3 shows pin 8 going to earth. It should go to the anode pentode wire because pin 8 is g2. When it is wired as in the wiring data, all pentode sections appear faulty on base 3.

Thanks to Mr. Peters for his most interesting and instructive valve series.—H. PATTERSON (Bolton).

SIR,—The illustration below may be of interest to you as an example of the practical application of the useful articles and circuits published in PRACTICAL TELEVISION.

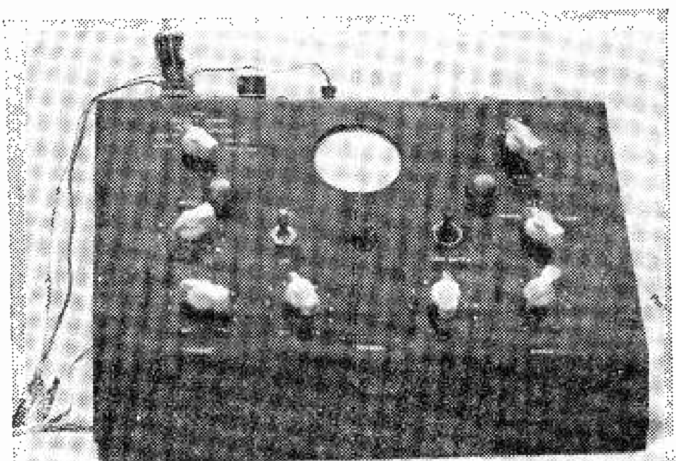
As you will observe, I have modified the design to some extent, and by slightly enlarging the cabinet have incorporated a CR tube circuit to replace the meter.

The instrument works very well, and has enabled me to weed out quite a number of faulty valves. In the matter of construction, I fortunately had a transformer with suitable filament tappings up to 70V, also a CRT and various metal rectifiers. In addition I possessed a number of unused single-pole, 12-way switches, and the main cost of the job was the knobs and metal panel.

The lettering and figuring were done by transfers, and in a few cases the words were made up of odd letters or parts of other words, and the whole wording and figuring finally sealed with clear lacquer.

The tester was something I had been waiting for for a long time to replace my old outfit, and all I have to do now is fit an appropriately calibrated escutcheon plate.

Thanking you for such a useful adjunct to the service workshop.—R. J. HALL (Hornchurch, Essex).



The valve tester constructed by Mr. Hall of Hornchurch.

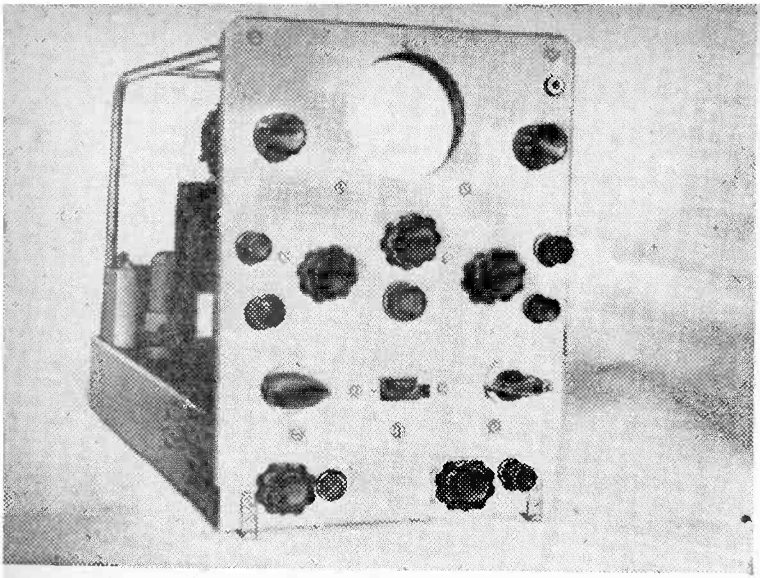
INTERLACING

SIR,—I recently had the pleasure of visiting a technical laboratory where some development work was taking place, and I saw here the timebases of your "Olympic" receiver at work. I was greatly impressed by the interlacing, and made a point of visiting a local showroom as soon as possible. There was not one set on demonstration which was interlacing properly. The lines were either paired or dithering about, and I feel surprised that no manufacturer has gone to the trouble of fitting a proper circuit of the type you used—all seem to prefer to rely upon a simple triode or, in some cases, a diode to provide the necessary interlace. One maker has gone to the trouble of providing a separate diode with an "interlace" control, but this is only a half-hearted attempt to tackle the problem, and I would have thought that the very much better picture which is obtained would itself have been sufficient advertisement to increase sales and repay them for the slight extra expense of valve and controls.—M. G. FERGUSON (Cardiff).

NOVEL AERIAL

SIR,—I expect many readers would be interested to hear of the following discovery which I made several days ago. In the loft I have an old 150ft length of flex which was used for a crystal set. I tried fitting this to the centre pin of the aerial connection on the television, and an almost perfect picture resulted, although the signal-to-noise ratio was rather high on the sound side. I was able almost to tune in Channel 10 by this arrangement, but the scope of the coils on the tuner would not allow me to do this. Channel 10 has never been tuned in at all before without this arrangement.—N. A. S. PAYN (Thorpe Bay, Essex).

A Basic



A TV Check 'Scope

apparent that the majority of TV waveforms could be observed and examined perfectly satisfactorily in its original state, and so it was accordingly left severely alone, life being considered complicated enough already.

A RECENT survey of small TV workshops revealed that just over half of them possessed an oscilloscope, and that in well over 5per cent of them it is actually in regular use. Enquiring more deeply into this deplorable state of affairs, it was noticed that in the majority of places where it is used regularly, it was used "straight" more often than not, and that like a sewing machine, the various attachments and facilities provided were more bother to "hook up" than they were worth.

With this in mind the instrument about to be described is offered. It is based on one that the writer constructed in a hurry over two years ago, vowing (as he always does) to finish it off properly later, but after using it for a few months, it was

Brief Description

In essence the "scope" has three parts, a power unit employing a standard 350V-0-350V mains transformer, a thyratron timebase, and an electrostatically deflected tube such as the ex-service VCR138 and VCR97. There must be thousands of these latter tubes in spare boxes throughout the country, relics of the days of the 6in. green screen wonder TV's which, although too dim to make much of a raster will still provide an acceptable single horizontal trace.

For simplicity no Y-amplifier is included. Most TV waveforms can be observed without one, and unless great care is taken with the design, trace distortion can be so bad that faults are looked for where none exist.

No critical values are employed, and with certain exceptions, most components can easily be halved or doubled in value and yet the 'scope will still perform.

Circuit Description

The nucleus of the instrument, apart from the tube itself is an old 350V-0-350V mains trans-

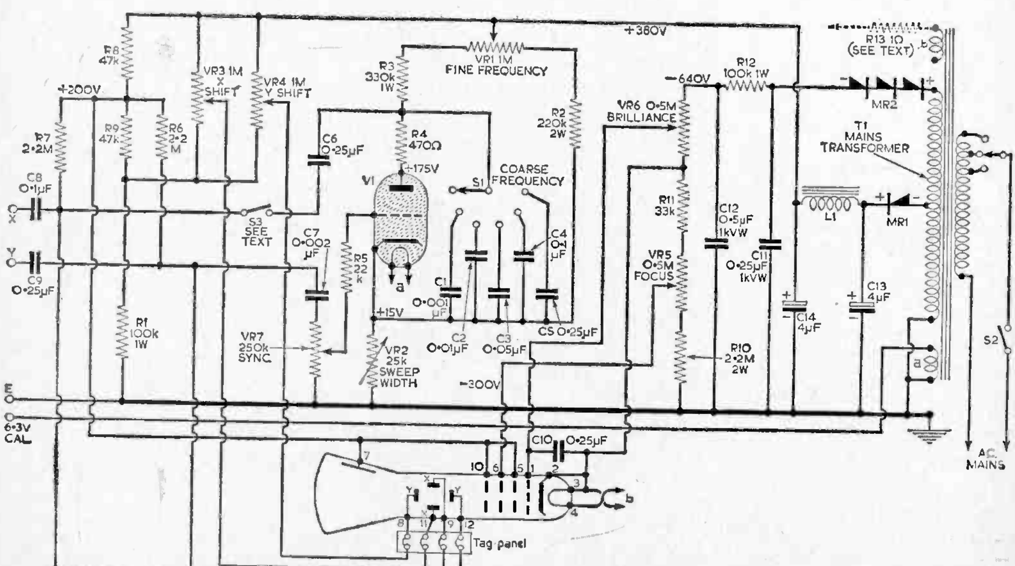


Fig. 1.—The circuit diagram of the oscilloscope.

TV Oscilloscope

By H. Peters

former. Its H.T. secondary is wired with one end to chassis. The centre tap is used to derive the H.T. positive supply (about 400V) and the end connection to produce the low current H.T. negative supply. MR1 and MR2 are constructed from groups of discarded metal rectifiers taken from portable radios and television receivers, details of which will be given in a later paragraph.

Tube Supply

Owing to the negligible current drain of the tube, the 700V winding of T1 can be made, with efficient smoothing, to present about 800-900V negative to chassis for the cathode of the tube. This is connected to the tube heater to prevent insulation breakdown and this in turn to winding "b" on T1, which is the winding which would normally supply the rectifier heater, and will be 4V on a 4V transformer, and 5V on the 6·3V type of transformer.

As the heaters of the two tubes mentioned above are both 4V, it will be necessary to insert a series resistor of 1Ω (R13) if the 5V transformer is used. This may be constructed using about a foot of resistance wire from an old firebar wound over a 1W carbon resistor and may later be shorted out to give 25per cent boost if desired.

The bleeder chain R10/VR5/R11/VR6 ensures that the negative H.T. supply loses its somewhat lethal charge upon switch-off, and at the same time it stabilises the voltages on the focus and brightness controls VR5 and 6.

Timebase

V1 is a thyratron (6K25 6V or T41 4V depending upon T1) sweep generator and has been chosen in preference to a Miller integrator on account of its simplicity. It has three main drawbacks. The scan is non-linear, being stretched at the beginning of the stroke and cramped towards the end, the sweep is only just sufficient to fill the tube from left to right, and synchronising can be rather touchy at low sweep frequencies. These disadvantages are more than outweighed by its reliability both in construction and operation.

Thyratron Action

Briefly the thyratron action is as follows: at the beginning of a stroke, the selected condenser of C1-C5 is charged up slowly from H.T. through VR1 and R3, the rate of charge—and thus the repetition frequency—being determined by the value of C1-5 and the setting of VR1, hence these become the coarse and fine frequency controls. When the voltage at the junction of R3 and R4 rises beyond the striking point of the valve, this conducts heavily and discharges the condenser, thus reducing the voltage at R3, R4 almost to zero, at which point the thyratron once more becomes non-conductive, permitting the charging (sweep) cycle to start all over again. The cathode bias on V1 is varied by VR2 and this determines the voltage at R3, R4 when the thyratron will strike. VR2 therefore will control the width of the trace, and to compensate for unwanted width variations owing to VR1 varying the H.T. on the thyratron anode, the 220k resistor R2 is added between the unused end of VR1 and the cathode of VR1.

As the voltage on the anode of V1 is increased by the movement of the slider of VR1 towards R3, the width will tend to decrease. At the same time resistance is added between the upper end of R2 and H.T., thus lowering the voltage at the lower end of R2 which is tied to V1 cathode thus increasing the sweep width. These two variations are about equal, and, by and large, cancel each other out giving substantially even width over most of the range of VR1.

Synchronising

The trace is synchronised to the incoming waveform by means of the coupling through R5 and

LIST OF COMPONENTS

Resistors

R1	100k 1W	R8	47k ½W
R2	220k 2W	R9	47k ½W
R3	330k 1W	R10	2·2M 2W
R4	470 Ω ¼W	R11	33k ½W
R5	22k ¼W	R12	100k 1W
R6	2·2M ½W	R13	1 Ω (see text)
R7	2·2M ½W		

Condensers

C1	0·001 μF 500VW	C9	0·25 μF 500VW
C2	0·01 μF 500VW	C10	0·25 μF 500VW
C3	0·05 μF 500VW	C11	0·25 μF 1000VW
C4	0·1 μF 500VW	C12	0·5 μF 1000VW
C5	0·25 μF 500VW	C13	4 μF 500VW (Electrolytic)
C6	0·25 μF 500VW	C14	4 μF 500VW (Electrolytic)
C7	0·002 μF 500VW		
C8	0·1 μF 500VW		

Controls

VR1 1M Fine Frequency (preferably with on/off switch)
VR2 25k Sweep Width
VR3 1M X-Shift
VR4 1M Y-Shift
VR5 ½M Focus
VR6 ½M Brilliance
VR7 250k Sync

Switches

S1 6-way, single-pole (Coarse frequency)
S2 Single-pole mains switch (May be ganged to VR6)
S3 Optional switch to disconnect Internal timebase (May be on VR1 if desired)

Rectifiers

MR1 See text or use 3 x RM2 in series
MR2 See text or use 2 x K8/40 Sentercel or 1 x 36EHT25 Westinghouse

Mains Transformer T1

Secondary 350V-0-350V
Heater windings either 2 x 4V or 1 x 6·3V and 1 x 5V

Valve V1

T41 with 4V transformer or
6K25 with 6V transformer

the potential divider VR7, which is the "sync" control. This is part of the input load of the modulated "Y" plate, and feeds up to 20per cent of the input signal to the grid of V1. Thyratrons need a small synchronising voltage to trigger the scan, which action is caused by positive-going portions of the applied waveform driving the thyratron to striking point an instant before it would have struck of its own accord.

C1-C5 have been chosen to provide repetition frequencies between a few cycles per second and about 6000c/s, the two in commonest use being 225c/s and 5,062c/s which are half frame and line frequency. The values given may be varied to suit the requirements of the user and are not unduly critical as an overlap usually exists at both ends of each range.

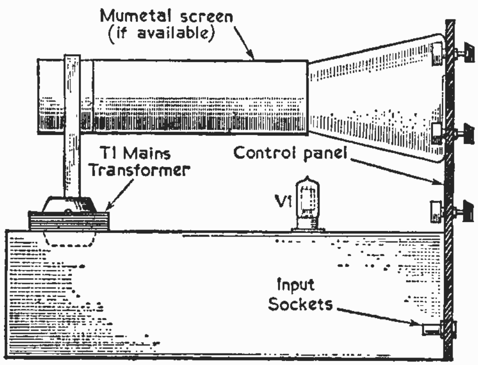


Fig. 2.—A suggested layout for the unit.

Shifts

VR3 and VR4 provide a variable voltage to the unmodulated X and Y plates, enabling the trace to be shifted up and down, or across the screen. The modulated plates are taken to the junction of R8 and R9, i.e. to a potential midway between the shift control ends, and to reduce astigmatism, A1, A3 and the internal coating of the tube are taken to the same point.

Tube Deflection

A panel of two groups of four solder tags is fitted close to the tube base with the four terminals nearest the tube taken to Y1 X1 X2 Y2 and the other four to Y-input, X-shift, X-input, and Y-shift respectively.

The cross connections are made with flexible wire and it is therefore possible easily to reverse the sense of either deflection. This is highly desirable in home construction so that incorrect connections can be readily rectified. Three common faults are possible after the initial wiring and the prototype naturally had them all.

They are: (1) X and Y shifts transposed.
(2) Trace upside down.
(3) Spot scans screen from right to left.

Besides enabling these three conditions to be speedily remedied the panel provides a means of transposing the X and Y plates, moving the trace through 90°.

When doing this, it should be remembered that the deflection sensitivity of each set of plates is different, and that some tubes suffer from "cut off" where the shadow of one set of plates is cast across the top and bottom or the sides of the trace, obscuring part of the waveform.

As an insight into the writer's mentality, condition (1) above was cured by changing over the labels on the knobs, whilst condition (2) was found to be so interesting that a reversing switch labelled "Trace Inverter" was permanently incorporated as the front panel control. This has since proved very useful as the second tube fitted to the 'scope did suffer badly from an uneven cut-off which distorted the tops of the waveforms and by rapidly inverting the trace it was immediately obvious whether the distortion were in the 'scope or the set under test.

Extra Facilities

The sawtooth voltage from the thyratron is fed via C6 to the X-plate of the tube with R6 as a D.C. leak. The sawtooth is also brought out to the "X" terminal via C8 so that a wobbulator can be used and so that "ringing" tests can be applied to inductances.

By switching S1 to the sixth position, the thyratron is "muted" and an external X-voltage may be fed in between the X-terminal and chassis. Less distortion will result if the feed is broken at S3 near C6, and this extra feature may be simply incorporated by using for VR1 a standard volume control with switch.

The 6·3V heater winding is also brought out to a terminal, where it may be used as a calibrating voltage. Bearing in mind that an oscilloscope gives peak readings, as opposed to a meter which reads root mean square, the display from this output is 18V from peak to peak ($6{\cdot}3 \times 1{\cdot}414 \times 2$) and for calibrating purposes may be called 20V. With the 4V transformer the output is of course 11·3V peak to peak.

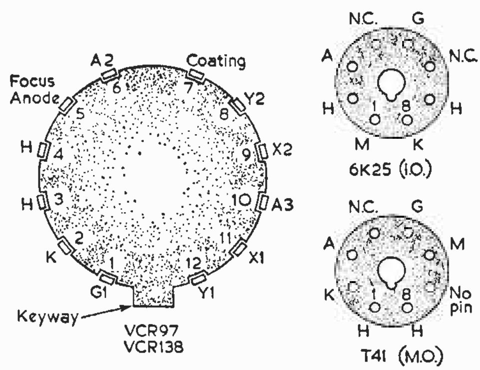


Fig. 3.—Valve and tube base connections. (If the tube connections for pins 8, 9, 11 and 12 are as given in Fig. 1, it must be mounted with the key-way uppermost.)

Construction

No precise constructional details are given as so much depends on the individual and his spares box, and also upon the tube in use. There are only two critical components. One is the mains transformer which must be mounted behind the tube with its core in line with the axis to reduce electromagnetic deflection, and the other is the input lead to the modulated Y-plate, which should be kept away from the timebase and mains transformer, and can be screened by using coaxial cable if desired.

Owing to its size, the VCR97 makes a better floor standing model than a bench instrument, but the VCR138 can be made into a manageable table model. The length of both types may be considerably reduced if mumetal screening is available for the tube, as liberties can then be taken with the mains transformer which can be brought up underneath the tube base, although still with its core parallel to the tube axis.

Controls

The controls may be salvaged from old receivers, and provided that they were originally rejected merely due to noisy operation, can be simply repaired and put into service. Broken tracks or flashovers to case cannot be repaired. Dual controls from television receivers are ideal in this respect, as they save a great deal of space on the front panel.

The writer's method of repairing noisy controls is as follows (his early tutors are asked to turn away): Carefully break open the control and blow out any loose particles. Pencil the track gently with a soft pencil taken round about three times, and if possible rub the pencilling over with the little finger. Pack the control with clean grease or vaseline, reassemble and measure. Normally the control ends up about 25per cent below its original value, which is sufficiently accurate for all those in the 'scope except VR1 where the overlap between ranges is desirable.

(Continued on page 474)

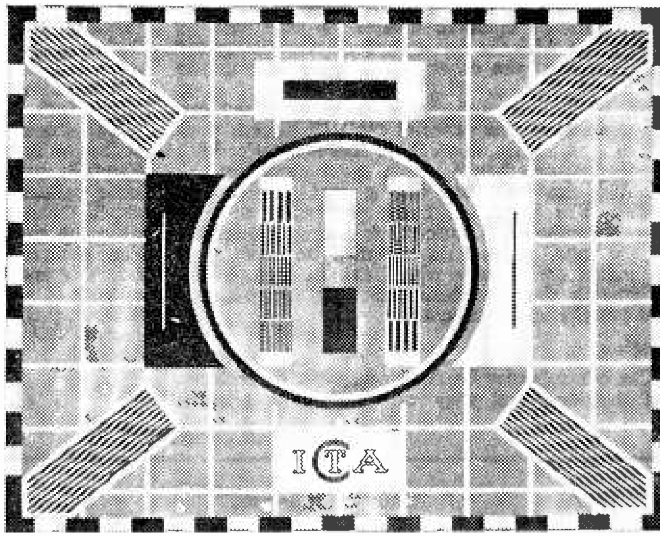
FAULT FINDING CHART

Fault.	*Initial Check Reveals.*	*Course of Action.*
'Scope appears dead.	*No valves light.*	*Check S2, voltage selector plug, T1.*
	Valves and tube light up.	*Check for presence of H.T. positive and H.T. negative voltages. Suspect MR1 or MR2 if absent.*
	Overheating.	*Look for H.T. shorts, suspect particularly C13, C14, C11, C12.*
	L.T. and H.T. supplies satisfactory	*Disconnect both X—and Y—plates at the connecting block and join all four to A3. Try to adjust VR5 and VR6 for a green spot in the tube centre. If no spot appears, short out C10. If spot then appears replace VR6. If no spot appears, suspect a faulty tube or break in R11, VR5, R10 chain. Having obtained spot, remove X—plates from A3 and reconnect to proper leads. X—shift should now move spot across screen. If not, check VR3, R8, R9, R7, and C6 for leakage Repeat procedure for Y plates, spot should move up and down. If not check VR4, R6, C7 for leakage.*
Very Dim Trace.	*L.T. and H.T. satisfactory focus and brilliance both operate.*	*Suspect "low" tube, short out R13 to give slight heater boost.*
Trace incorrect. (The spot should scan the tube from left to right.)	*Spot scans up and down or right to left, or diagonally.*	*Rearrange X—and Y—plate connections at terminal block. A diagonal trace indicates that one X—and one Y—plate have been crossed.*
	Timebase works but shift controls do not move trace.	*Check R1, R8, R9, voltage at junction R8/C9. Suspect leaky C6.*
	Trace will not focus control at end of travel.	*Increase or decrease R11.*
	Spot of light but no trace.	*Check for positive H.T., feel if thyratron is heating.*
	Trace only appears on certain positions of S1.	*Check for leaky condensers (C1—5) on the position of the switch where there is no scan.*
	Trace will not synchronise.	*Suspect C7, VR7, R5, and the thyratron. The latter can be checked by linking the 6.3V "Cal" socket to the grid of the thyratron. If the valve is satisfactory, a frame trace from a TV receiver will lock in.*
	Alteration of sync and sweep control make it necessary to re-adjust VR1.	*This is normal to some extent, but if very bad can be caused by poor H.T. and regulation or leaky C6, and C7.*
	No control of brightness.	*Check for C10 shorted, or a grid-cathode leak on the C.R. Tube.*

Television Interference

RECOGNITION, CAUSES AND CURE

By L. E. Higgs



Test card "C" as it is transmitted.

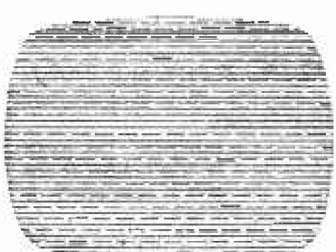
RECOGNISING the many varied types of interference that can occur on the vision and sound channels of television is an art in itself, but one that can avoid aimless probing in circuits looking for a fault in the wrong place—a fault that may not even exist if the trouble proves to be external. The classic groups of radio interference are "man-made" and "natural" (the old "atmospherics"). These divisions still hold good today with the greatest trouble caused by the ever-increasing quantity of electrical equipment coming into use. However, a sub-section can be added to the man-made type that is of especial interest to us, and that is interference picked up on a receiver which originates *inside* the same set. Brushing from EHT is one example of this group.

Brushing

This effect consists of the random distribution of white spots all over the screen with no effect from the loudspeaker, but with a soft noise from the rear of the cabinet. It is caused by a succession of weak sparks from high voltage points in the receiver (across damp, dirty or defective insulation) which transmit small bursts of radio frequency to be picked up by the aerial or by unscreened parts of the wiring. Thus, a white spot on the raster is produced. Removing the aerial from the set will show if the interference is arriving from the aerial or from wiring—the spots disappear if it is from the aerial. The position of the spots on the screen indicates where the brushing is taking place. If they are equally spaced all over the screen (Fig. 1), the brushing is from the EHT D.C. output point. A vertical column of "fishes"—pear shaped streaks—down the raster (Fig. 2), almost always is the result of A.C. brushing at the anode of the EHT rectifier. Severe, brilliant, stripes of light formed at the left-hand side of the raster (Fig. 3) accompanied by line whistle from the loudspeaker is the symptom of line arcing and it is advisable to switch off should this suddenly appear, as insulation in the scan coils or line output transformer can be damaged if it is allowed to continue. For all cases of brushing or corona, turning out the room lights and looking at the chassis in the dark for tell-tale sparks or blue light is the best approach.

Parasitic Line Oscillations

These produce a wobbly, thin, vertical line down the screen that varies its position within half an inch or so, and looks like a column of water from a tap (Fig. 4). It is also known as the Barkhausen-Kurz effect. These spurious oscillations are produced for a minute instant during the line scan (Fig. 5). The oscillations are radiated from the high level energy circuit of the output line valve and are received at the aerial or input circuit of the set—appearing as a thin column of shimmering spots on the raster when the line timebase is synchronised. This radiated interference can also be received on nearby sets, and the interesting symptom to notice here is that the line will remain stationary if the interfering and



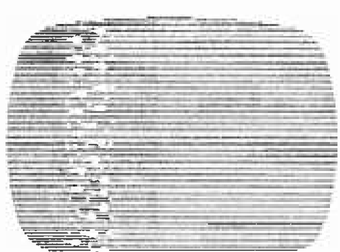
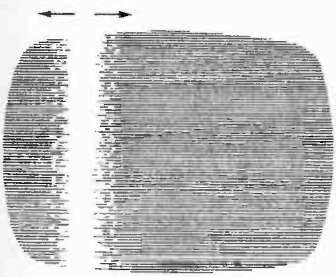


Fig. 1 (left).—D.C. EHT brushing gives rise to evenly spaced white spots over the entire picture.

Fig. 2 (right).—A.C. EHT brushing gives a vertical column of spots on the screen.

receiving sets are on the same channel. The line will, however, wander over the screen—disappearing on one side and reappearing from the other side—if the two sets are on different channels. This helps to track down an offending set because it is easy to determine from which channel the interference proceeds—one merely asks one's neighbour what programme he is watching.



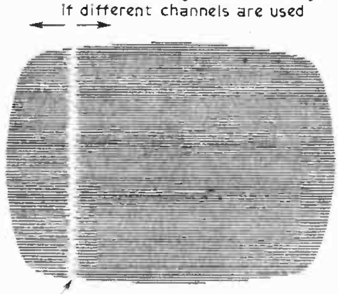


Fig. 3 (left).—Arcing in the line section gives a brilliant ragged band on the picture, with a noise from the loudspeaker.

Fig. 4 (right).—Parasitic (Barkhausen-Kurz) oscillations in the line output stage produce a thin, vertical, grey line which may move across the screen.

Spark Discharges

Motor vehicle ignition is the best known of this group which is still too prevalent despite the GPO requirement to limit it by suppression. The interference which forms horizontal lines or bands of small bright spots across the screen travelling up or down (Fig. 6), is radiated by the vehicle wiring from each spark plug discharge. Plug suppressors are an effective cure or a better sited aerial to increase the signal to noise ratio. Band III is less affected by spark discharge than Band I.

Electrical Machines

The commutator of domestic electric motors produces sparks and TV interference in increasing amount as the brushes wear and the machine ages. The effect on the screen is one or two thick bands of spots (Fig. 7) accelerating up and down the screen accompanied by a rattle and buzz from the sound. The speed of the offending machine decides the pattern of movement of the bar of spots on the screen but by studying the period of time it lasts and the time of day during which it exists, one can deduce the source from which it comes. For instance, sewing machines operate in short bursts of about 5-30sec followed by a pause during which the operator adjusts her material.

Washers and Vacuum Cleaners

These produce a continuously moving band for 5-15minutes. At one time, the effects were confined to morning, but with more and more women out at work and catching up with the chores during the evening this form of interference is on the increase. A GPO investigation is the best approach.

Thermostat Splutter

This effect of a prolonged, drawn out, bright splutter of light across the screen accompanied by spots and complete loss of sync, with a sizzling buzz from the sound for a period of one to five seconds, repeated every ten minutes or so, generally originates from domestic heat-controlled smoothing irons with a sluggish cut-out and which, probably, are not earthed. Water heater thermostats seldom cause interference because they are deeply immersed in an efficiently earthed water jacket.

Most up-to-date equipment, in good condition and correctly installed, gives little or no trouble to TV.

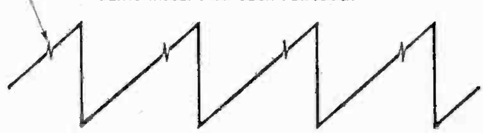
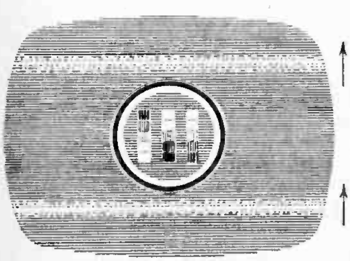


Fig. 5.—The line timebase waveform with parasitic oscillations indicated.



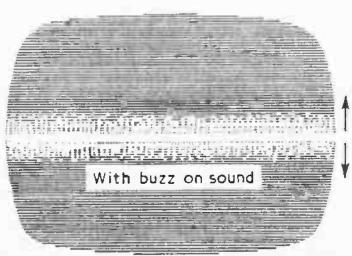


Fig. 6 (left).—Interference from motor vehicles forms horizontal lines or bands of spots which travel up or down.

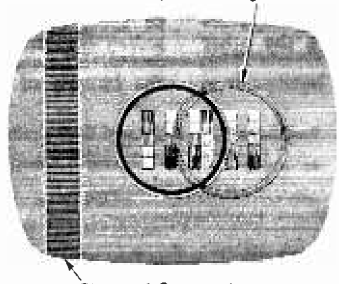
Fig. 7 (right).—Interference from electric motors gives one or two thick bands of spots, accompanied by a rattle and buzz from the loudspeaker.

Fluorescent Discharge

This trouble shows as a soft bar of light across the screen, not with random spots as with machines but always stationary across the raster when synchronised with the mains frequency, or rolling steadily up or down the screen slowly, if out of sync with the mains. There may be a steady background buzz but not the irregular rattle, as from machines. This is mainly found in industrial areas near offices, shops or factories where more fluorescent lights are used than in residential districts. The cause is faulty lamp gear or incorrect installation.

Multi-Path Reflections

"Ghost" is the well-known name for double images on the right-hand side of the main subject on the raster. These are due to a reflected signal arriving a little later, after the main one has been "painted" on the screen. What is less well-known is that there are two varieties: *positive* images (Fig. 8)—where a black main subject causes a black image and *negative* images (Fig. 9)—where a black main subject causes a white image. These can exist singly, in multiples, or both kinds together in multiples. They are caused by large blocks of masonry or steel, or rock in the form of mountains and hills from which the TV signals rebound. The only treatment (not always a cure, unfortunately) is to try directional or screened aerials or arrays.



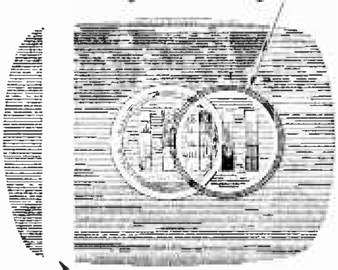


Fig. 8 (left).—A positive ghost produced by reflection of the signal.
Fig. 9 (right).—A negative, or reversed, ghost.

(To be continued)

SERVICING TELEVISION RECEIVERS

(Continued from page 466)

VR11. Line Hold

This is set to hold the picture in a horizontal sense. It is not sufficient to adjust it to hold the picture on one channel only. Set it so that the channel switch can be rotated without the picture being lost.

Width

This control is situated on the line output transformer assembly. Slacken the knurled screw and adjust to overlap the sides slightly and produce a true circle in conjunction with the height control.

Linearity

This is a sleeve on the tube neck which slides under the scanning coils to provide correct left to right relationship of the picture, i.e., it expands and contracts one side with respect to the other. The scanning coil clamp should be slackened before moving the sleeve.

Picture Shift

There is a magnet (black) set in a bracket immediately to the rear of the scanning coils. Rotation of the bracket produces a movement of the whole picture on the screen whilst rotation of magnet varies the intensity of the magnetic field and thus the amount of movement in a particular direction. There is no ion trap magnet.

On-off Switch

This is mounted on the brilliance control and one side of the switch also opens the control connection to chassis. The purpose of this is to raise the brilliance control potential (and the CRT grid) to that of the H.T. line, which collapses slowly upon switching off, thus causing a fairly heavy beam current which discharges the EHT system and prevents the appearance of a spot of light in the centre of the tube. ■

A Basic TV Oscilloscope

(Continued from page 471)

Metal Rectifiers

The most readily available source of supply of metal rectifiers is old television receivers, and old mains-battery portables, and rectifiers which have been discarded from these equipments for low output do very well in the 'scope where the current drain is negligible.

Do not, however, risk fitting a selenium rectifier which has broken down on one or two sections. These give off an offensive smell which will make the instrument impossible to hide and prevent the user from concentrating properly when fault-finding. For the H.T. positive rectifier MR1 a pair of old RM4's or RM5's will serve very well, as will four RM2's or RM3's, or a modified 14A86 or 14A100. Two contact-cooled rectifiers 14RA1283 or 14RA1282 are also satisfactory. There is no reason why a valve rectifier should not be used, provided a suitable, well insulated, heater winding is available on the mains transformer. This would not be necessary with a 6U4 or EY81 efficiency diode.

For the H.T. negative side, three RM4's or similar will be needed, and although in theory they are being over-run, in terms of voltage applied, in practice they remain quite cool and work very well for long periods since very little current is being drawn. If space is at a premium, 1½ modified 14A86's or 6RM2's or RM3's with the cooling washers removed will do the trick. A word about modifying the 14A86: This comprises a pair of rectifiers mounted back to back (or facing inwards, whichever way you prefer) and the modification consists of removing one half, reversing its polarity and re-fitting it.

This action halves its current handling capacity and doubles its peak inverse voltage rating. Since the total current drawn is about a milliamp the cooling fins may also be carefully removed.

(To be continued)

VALVE TESTING DATA

FOR THE "UNIVERSAL VALVE TESTER"

By J. Hillman

THE valve testing information given below is intended for use with the Universal Valve Tester, which was described in the May 1960 issue of "Practical Television".

It should be noted that all ten valveholders on the tester are wired up together—the wander plug from the grid socket is placed in the socket required on the large British 9-pin valveholder. This number is given below for each valve.

When wiring up S9b, there should be no connection between tags 2 and 3.

Valves are listed in alphabetical order and the following headings are used:—

Vh—the Heater Voltage and the Heater switch should be set to this value.

Heaters—the settings for switches S5, S6.

A—the setting for switch S4.

Sc—the setting for switch S8.

G—the setting for a lead from the grid socket on the top of the tester to the appropriate pin of the B9 valveholder or to the top cap when necessary.

K—the setting for switch S7.

Sw—the setting for the selector switch S2.

Emission—the reading of emission given by a new valve (in mA).

"BRITISH" TYPES

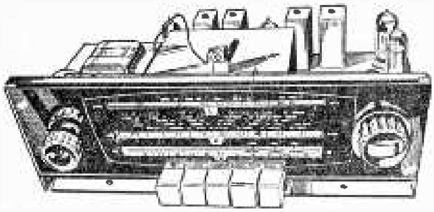
Valve	Vh	Heaters	A	Sc	G	K	Sw	Emissian (mA)
AZ31	4	2 and 8	6	–	–	8	4	11
CBL31	30	2 and 7	5	6	TC	8	3	19
CCH35	6	2 and 7	3	4	TC	8	3	11
CL33	30	2 and 7	3	4	5	8	2	21
CY31	20	2 and 7	5	–	–	8	4	11
DF96	1	4 and 5	6	7	3	4	4	6
DF91	1	4 and 5	6	7	3	4	4	6
DF33	1	2 and 7	3	4	TC	7	4	6
DAF96	1	4 and 5	2	1	3	4	4	1
DAF91	1	4 and 5	2	1	3	4	4	1
DK96	1	4 and 5	6	7	1	4	4	3
DK91	1	4 and 5	6	7	1	4	4	3
DK32	1	2 and 7	3	4	5	7	4	3
DL33	1	2 and 7	3	4	5	7	4	6
DL35	1	2 and 7	3	4	5	7	4	6
DL92	1	4 and 5	6	1	7	4	4	8
DL94	1	4 and 5	6	7	3	4	4	8
DL96	1	4 and 5	6	7	3	4	4	8
DW4-350	4	3 and 4	1	–	–	4	4	11
DW4-500	4	3 and 4	1	–	–	4	4	11
DK92	1	4 and 5	6	7	1	4	5	3
EABC80	6	4 and 5	2	–	8	7	4	5
EAF41	6	1 and 8	2	5	6	7	3	10
EAF42	6	1 and 8	2	5	6	7	3	10
EB41	6	1 and 8	4	–	–	3	6	3
EB91	6	1 and 7	4	–	–	2	6	3
EBC33	6	2 and 7	3	–	TC	8	3	5
EBC41	6	1 and 8	2	–	3	7	4	4
EBC91	6	1 and 7	4	–	5	6	4	4
EBC81	6	4 and 5	1	–	2	3	4	5
EBF80	6	4 and 5	6	1	2	3	3	9
EBF89	6	4 and 5	6	1	2	3	3	9
EBF83	6	4 and 5	6	1	2	3	3	9
EBL21	6	1 and 8	2	4	3	7	3	17
EBL31	6	2 and 7	3	6	TC	8	3	19
ECC31	6	2 and 7	6	–	5	8	3	13
ECC33	6	7 and 8	2	–	1	3	3	16
ECC81	13	4 and 5	1	–	2	3	3	12
ECC82	13	4 and 5	1	–	2	3	3	7
ECC83	13	4 and 5	1	–	2	3	3	4
ECC91	6	1 and 7	5	–	2	4	3	4
ECC88	6	4 and 5	1	–	2	3	4	9
ECF80	6	4 and 5	6	3	2	7	3	2
ECF82	6	4 and 5	6	3	2	7	3	6
ECH81	6	4 and 5	6	1	2	7	3	6
ECH42	6	1 and 8	2	5	6	7	3	11
ECH35	6	2 and 7	3	4	TC	8	3	10
ECH21	6	1 and 8	2	5	6	9	3	8
ECL82	6	4 and 5	6	7	3	2	3	15
ECL80	6	4 and 5	6	8	9	3	3	11
ECL83	6	4 and 5	6	8	9	7	3	11

Valve	Vh	Heaters	A	Sc	G	K	Sw	Emission (mA)
EF37A	6	2 and 7	3	4	TC	8	3	9
EF22	6	1 and 8	2	3	6	7	3	10
EF39	6	2 and 7	3	4	TC	8	3	11
EF40	6	1 and 8	2	6	5	7	2	10
EF41	6	1 and 8	2	5	6	7	2	11
EF42	6	1 and 8	2	5	6	7	2	10
EF50	6	1 and 9	3	2	7	6	3	9
EF80	6	4 and 5	7	8	2	1	2	12
EF85	6	4 and 5	7	8	2	1	2	15
EF86	6	4 and 5	6	1	9	3	2	10
EF89	6	4 and 5	7	8	2	3	2	12
EF91	6	1 and 7	2	4	5	6	2	8
EF92	6	1 and 7	2	4	5	6	3	7
EK32	6	2 and 7	3	4	5	8	3	5
EL33	6	2 and 7	3	4	5	8	3	17
EL38	6	2 and 7	TC	4	5	8	3	17
EL84	6	4 and 5	7	9	2	3	3	23
EL41	6	1 and 8	2	5	6	7	3	18
EY86	6	1 and 2	TC	–	–	1	2	22
EZ35	6	2 and 7	3	–	–	8	4	11
EZ40	6	1 and 8	2	–	–	7	4	11
EZ41	6	1 and 8	2	–	–	7	4	11
EZ80	6	4 and 5	1	–	–	3	4	11
FC2	2	4 and 5	7	3	TC	4	4	5
FC2A	2	4 and 5	7	3	TC	4	4	5
FC4	4	4 and 5	7	3	TC	6	3	8
FW4-500	4	3 and 4	2	–	–	4	4	11
GZ32	5	2 and 8	4	–	–	8	4	11
HL41DD	4	1 and 8	3	–	TC	2	3	14
HL23DD	2	1 and 8	3	–	TC	8	4	6
W4 350	4	3 and 4	1	–	–	3	4	11
IW4 500	4	3 and 4	1	–	–	3	4	11
KBC32	2	2 and 7	3	–	TC	2	4	5
KF35	2	2 and 7	3	4	TC	2	4	6
KK32	2	2 and 7	3	4	TC	2	4	5
KL35	2	2 and 7	3	4	5	2	4	7
KLL32	2	2 and 7	3	8	4	2	4	6
KT61	6	2 and 7	3	4	5	8	3	15
PCC84	6	4 and 5	3	–	2	1	4	7
PCF80	9	4 and 5	6	3	2	7	4	7
PCL82	15	4 and 5	6	7	1	2	3	15
PCL83	13	4 and 5	6	8	9	7	4	8
PCL84	15	4 and 5	6	9	8	7	4	2
PCC88	6	4 and 5	1	–	2	3	4	10
MKT4	4	3 and 4	1	9	2	5	3	16
MX40	4	4 and 5	1	3	2	6	3	9
N78	6	1 and 7	2	4	5	6	3	13
PCC89	6	4 and 5	3	–	2	1	4	7
PABC80	9	4 and 5	6/9	–	8	7	3	5
PCF82	9	4 and 5	6	3	2	7	3	6
PEN 25	2	1 and 8	3	4	5	8	4	7

Valve	Vh	Heaters	A	Sc	G	K	Sw	Emission (mA)
PM2B	2	4 and 5	3	-	2	4	4	4
PM24M	4	3 and 4	1	5	2	4	2	18
PX4	4	3 and 4	1	-	2	4	3	30
PY31	15	2 and 7	5	-	-	8	4	12
PY32	30	2 and 7	5	-	-	8	4	12
PY80	20	4 and 5	9	-	-	3	4	12
PY81	15	4 and 5	9	-	-	TC	4	12
PY82	20	4 and 5	9	-	-	3	4	12
PY83	20	4 and 5	9	-	-	TC	4	12
PZ30	30	2 and 7	3	-	-	4	4	12
QP21	2	4 and 5	7	6	1	4	4	7
PL81	20	4 and 5	TC	8	2	3	3	28
PL82	15	4 and 5	7	9	2	3	2	21
PL83	15	4 and 5	7	1	2	3	2	21
PL820	20	4 and 5	TC	8	2	3	3	27
PEN A4	4	4 and 5	7	3	2	6	2	20
PEN B4	4	4 and 5	7	3	2	6	2	23
PL33	20	2 and 7	3	4	5	8	2	20
PL36	24	2 and 7	TC	4	5	8	3	25
PL38	30	2 and 7	TC	4	5	8	2	19
PEN 45	4	1 and 8	3	4	5	2	3	17
PEN 45DD	4	1 and 8	3	4	TC	2	3	16
SP2	2	4 and 5	TC	7	2	4	5	6
SP4 5pin	4	3 and 4	TC	1	2	5	3	10
SP4 7pin	4	4 and 5	TC	7	2	6	3	10
TDD4	4	4 and 5	7	-	TC	6	3	10
TDD2A	2	3 and 4	1	-	TC	3	4	6
TP25	2	1 and 8	3	7	TC	8	4	5
UAF41	13	1 and 8	2	5	6	7	3	10
UAF42	13	1 and 8	2	5	6	7	3	10
UABC80	24	1 and 8	1/9	-	8	7	3	5
UBC41	15	1 and 8	2	-	3	7	3	5
UB41	20	1 and 8	4/6	-	-	3/7	6	3
UBF80	15	4 and 5	6	1	2	3	3	8
UBF89	20	4 and 5	6	1	2	3	3	8
UCH42	15	1 and 8	2	5	6	7	4	6
UCH81	20	4 and 5	6	1	2	3	3	8
UCL82	30	4 and 5	6	7	3	2	3	15
UCL83	30	4 and 5	6	8	9	7	3	16
UCC85	24	4 and 5	1	-	2	3	3	15
UF41	13	1 and 8	2	5	6	7	3	10
UL41	30	1 and 8	2	5	6	7	3	20
UL46	30	1 and 8	2	5	6	7	3	20
UL44	30	1 and 8	TC	5	6	7	3	10
UL84	30	4 and 5	7	9	2	3	3	20
URIC	20	3 and 4	1	-	-	5	4	11
UYIN	30	1 and 8	3	-	-	7	4	11
UY85	30	4 and 5	9	-	-	3	4	11
UY21	30	1 and 8	3	-	-	7	4	11
UY41	30	1 and 8	2	-	-	7	4	11
U50	5	2 and 8	4/6	-	-	8	4	11
UU8	4	1 and 8	3/5	-	-	1	4	11
UU6	4	1 and 8	3/5	-	-	1	4	11
UU9	6	1 and 8	2/6	-	-	7	4	11
U26	2	1 and 2	TC	-	-	1	4	9
U118	30	1 and 8	2	-	-	7	4	11
U191	15	7 and 8	5	-	-	TC	4	11
U251	24	4 and 5	9	-	-	TC	4	11
U281	24	2 and 7	5	-	-	8	4	11
U282	24	7 and 8	TC	-	-	3	4	11
U301	24	7 and 8	5	-	-	TC	4	11
U339	15	7 and 8	5	-	-	TC	4	11
U801	30	2 and 7	3,4,5,6	-	-	1 9	4	11
U404	30	1 and 8	2	-	-	7	4	11
VP2	2	4 and 5	TC	7	2	4	4	5
VP2B	2	4 and 5	2	7	TC	4	4	7
VP4B	4	4 and 5	2	7	TC	6	3	9
VP4 7pin	4	4 and 5	TC	7	2	6	3	11
VP4 5pin	4	3 and 4	TC	1	2	5	3	10
W21	2	4 and 5	TC	7	2	4	4	5
X14	1	2 and 7	3	6	5	2	4	3
X78	6	1 and 7	2	5	6	7	4	5
X79	6	4 and 5	6	1	2	3	4	6

"AMERICAN" TYPES

Valve	Vh	Heaters	A	Sc	G	K	Sw	Emission (mA)
1A7	1	2 and 7	3	4	5	7	4	3
1C5	1	2 and 7	3	4	5	7	4	6
1D5	30	3 and 4	1	-	-	5	4	11
1H5	1	2 and 7	3	-	TC	7	4	-
1N5	1	2 and 7	3	4	TC	7	4	6
1R5	1	4 and 5	6	7	1	4	5	3
1S4	1	4 and 5	6	1	7	4	4	8
1S5	1	4 and 5	2	1	3	4	4	1
1T4	1	4 and 5	6	7	3	4	4	6
2P	2	3 and 4	1	-	2	4	-	-
2D2	2	3 and 4	1	-	-	5	-	-
2D4A	4	3 and 4	1	-	-	5	-	-
3S4	2	4 and 5	6	1	7	4	4	8
3V4	2	4 and 5	6	7	3	4	4	8
5R4	5	2 and 8	4	-	-	8	4	11
5U4	5	2 and 8	4	-	-	8	4	11
5V4	5	2 and 8	4	-	-	8	4	11
5Y3	5	2 and 8	4	-	-	8	4	11
5Z4	5	2 and 8	4	-	-	8	4	11
6AL5	6	1 and 7	7	-	-	2	6	3
6AK6	6	1 and 7	2	3	5	4	3	14
6AM6	6	1 and 7	2	4	5	6	2	8
6AT6	6	1 and 7	4	-	5	6	3	7
6BA6	6	1 and 7	2	3	5	4	3	9
6BE6	6	1 and 7	2	3	5	6	3	6
6BW6	6	4 and 5	7	8	2	3	3	17
6F6	6	2 and 7	3	4	5	8	3	16
6J7	6	2 and 7	3	4	TC	8	3	9
6K7	6	2 and 7	3	4	TC	8	3	11
6K8	6	2 and 7	3	4	TC	8	3	7
6L6	6	2 and 7	3	4	5	8	3	22
6Q7	6	2 and 7	3	-	TC	8	3	5
6SK7	6	2 and 7	8	6	4	5	3	11
6SN7	6	7 and 8	2	-	1	3	3	17
6V6	6	2 and 7	3	4	5	8	3	20
6X5	6	2 and 7	3	-	-	8	4	11
6U4	6	7 and 8	5	-	-	3	4	11
6X4	6	1 and 7	3	-	-	4	4	11
6U7	6	2 and 7	3	4	TC	8	3	12
6C5	6	2 and 7	3	-	5	8	3	16
6/30L2	6	4 and 5	1	-	2	3	4	9
6D2	6	1 and 7	4	-	-	5	6	3
6F13	6	1 and 8	2	5	6	7	3	12
6F15	6	1 and 8	2	5	6	7	3	14
6F18	6	4 and 5	7	8	2	1	3	12
6F19	6	4 and 5	7	8	2	1	3	12
6C9	6	1 and 8	2	5	6	7	3	7
6C10	6	1 and 8	2	5	6	7	3	11
6LD20	6	1 and 8	2	-	3	7	3	13
6L18	6	1 and 8	2	-	6	7	4	10
7B7	6	1 and 8	2	3	6	7	3	12
7C5	6	1 and 8	2	3	6	7	3	20
7C6	6	1 and 8	2	-	3	4	3	3
7S7	6	1 and 8	2	5	6	7	3	9
7Y4	6	1 and 8	3	-	-	7	4	11
7R7	6	1 and 8	2	5	6	7	4	10
7C7	6	1 and 8	2	3	6	7	4	11
10F9	13	1 and 8	2	5	6	7	3	11
10F1	20	1 and 8	2	4	6	5	3	11
10LD11	15	1 and 8	2	-	3	7	4	7
10LD12	24	4 and 5	6/9	-	8	7	3	6
10C1	24	1 and 8	2	5	6	7	3	8
10C2	24	1 and 8	2	5	6	7	3	11
10F18	13	4 and 5	7	8	2	1	4	7
12A6	13	2 and 7	3	4	5	8	3	18
12C8	13	2 and 7	3	6	TC	8	3	11
12J7	13	2 and 7	3	4	TC	8	3	10
12K7	13	2 and 7	3	4	TC	8	3	11
12K8	13	2 and 7	3	4	TC	8	3	7
12Q7	13	2 and 7	3	-	TC	8	3	5
12SJ7	13	2 and 7	8	6	4	5	3	10
12SK7	13	2 and 7	8	6	4	5	3	11
12SQ7	13	7 and 8	6	-	2	3	3	5
12SN7	13	7 and 8	2	-	1	3	3	16
14S7	13	1 and 8	2	5	6	7	3	9
20P5	20	1 and 8	2	5	6	7	3	18
20L1	13	1 and 8	2	-	3	4	4	9
185BT	15	2 and 7	TC	4	5	8	3	23
220 T	2	3 and 4	1	5	2	4	4	8
25L6	24	2 and 7	3	4	5	8	3	22
25Z4	24	2 and 7	3	-	-	8	4	11
35L6	30	2 and 7	3	4	5	8	3	15
35Z4	30	2 and 7	5	-	-	8	4	11
35W4	30	1 and 7	2	-	-	4	4	11
35Z5	30	2 and 7	5	-	-	8	4	11
35A5	30	1 and 8	2	3	6	7	3	25
50L6	30	2 and 7	3	4	5	8	3	18
66KU	6	1 and 8	2	-	-	7	4	11



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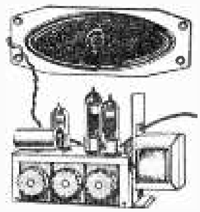

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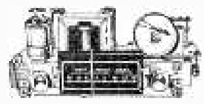

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Underneath the Dipole

A MONTHLY COMMENTARY

By Iconos

THE outside broadcast season is with us again. The BBC and the ITV programme companies have prepared their plans for putting on the home screen more outside events than ever before—cricket, horse and motor racing, show jumping, seaside summer shows, swimming, athletics and agricultural shows, ad infinitum. Religious services, public meetings, theatre and similar "interior" outside broadcasts are spread fairly evenly all the year round, but when the trees begin to blossom, and the trout begin to rise, the outside broadcast crews get ready to rush their equipment from one event to another.

Early Outside Broadcasts—and Telerecordings

It doesn't seem so long ago that the BBC made their first outside broadcasts. These were, I think, the Coronation of King George VI—which was covered by one fixed camera at Apsley Gate, Hyde Park—and the horse racing at the Alexandra Palace race course. The early Emitron cameras used for these events now seem almost as primitive as a Daguerrotype tin-type camera of a hundred years ago. With one lens, no "zoom", no viewfinder and with tripods improvised from film studio equipment, the BBC put up shows which were great pioneering achievements. What a pity that some of these early O.B.s weren't video-taped—a development which seemed utterly impossible at that time.

It wasn't long before the BBC improvised a form of telerecording on film, however, and some of these films might well be brought out of the archives in a scrapbook type of programme. The quality would be poor, of course, as the method used was to photograph only one of the interlaced fields at 25 frames per second, using a standard 35mm cine camera. Apart from various photographic degradations, therefore, the picture was virtually on a standard of less than 200 lines. Phillip Dorté, who is now the Controller of ATV in Birmingham, was the instigator of many of these early developments on BBC television.

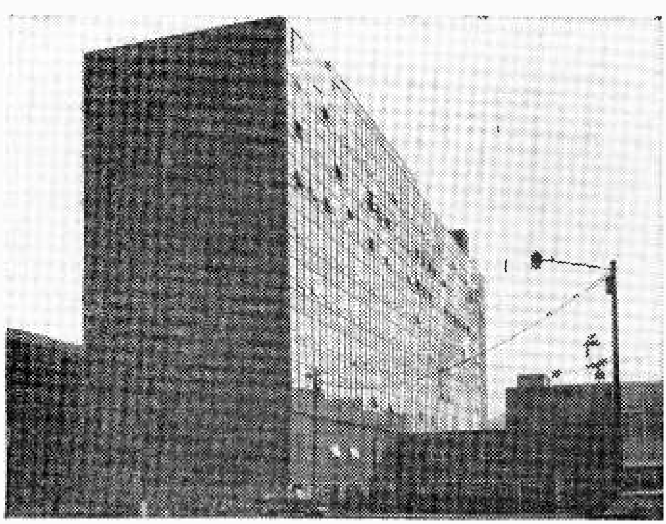
Flexibility

As for the scope of the earliest outside television broadcasts in Britain and America, the cameras were firmly anchored to one spot and had to be close to the terminal point of a co-axial cable to the Alexandra Palace, with high quality "music" telephone lines available over which the sound was sent.

Nowadays, flexibility has come to outside broadcasts through the enormous improvements in TV cameras and their accessories, including zoom lenses, lightweight control equipment, smaller O.B. vans and the extended use of microwave link apparatus—not to mention the professional polish of expert presentation that has resulted from the know-how and experience of the engineers and producers. The costs of outside television broadcasts are enormous. The crews have increased from the original eight or nine engineers for a 3-camera truck—and production assistants, riggers, drivers and all kinds of necessary hangers-on, including the producers, have expanded the complement to anything up to 30 or 40 people, and even more for very important events!

Sparkle

There is no doubt that outside television events broadcast "live" have a greater sparkle and immediacy than filmed events or even of televised events which have been recorded on video tape. The growing complications and costs of day-by-day O.B. operation already mentioned have made some of the ITV programme companies and even the BBC pause. But there is the periodic top-grade outside broadcast which seems to make the whole vast organisation worthwhile. The Grand National was



Part of the Granada TV centre in Manchester — the newly completed administrative block.

just such an event and the BBC's expert and imaginative handling of it resulted in one of the most thrilling sporting events yet screened. The fifteen cameras strategically sited around the course were supplemented on a truck running alongside the course, using microwave link connection with the mobile control rooms behind the grandstands. A zoom lens on the camera covered the final scene of bringing in the winner, Nicholaus Silver, and this shot slowly zoomed into a close shot of the jockey, looking very happy, acknowledging the cheers and patting his mount. The producers, Lakeland, Monger and Vernon, resisted the temptation to cut away to other cameras and gave the viewers the opportunity to watch and enjoy with the jockey his great triumph. This shot alone must have lasted a couple of minutes, and was a really human high-spot.

Thanks for the Memory

I must confess that I enjoy "scrapbook" programmes of the days of twenty years ago, whether they are slightly academic, such as the ATV's Alan Taylor lectures on political personalities of the past or of light entertainment of the old-time music hall or "thanks for the memory" type. Always nostalgic and sometimes a target for satire or burlesque, the old-time music hall performers bring back to me memories of delightful visits to variety shows in my schooldays.

A few of these real old-time performers made quite a hit before the war in the earliest transmissions from the Alexandra Palace, when George Robey, Albert Whelan, Fred Barnes, Lupino Lane, George Gee, Hetty King—and even Charles Coburn, made brief appearances. My son's friends were not always impressed with the simple but, to my mind, effective presentation of these old-time personalities. The teenagers of today work themselves into a frenzy when Adam Faith, Tommy Steele, Cliff Richard, Terry Dene or other "top of the disc pops" appear on TV or make a personal appearance at a local cinema. These are some of the young stars of today, potential performers for the "thanks for the memory" shows of twenty years hence. By that time, there will be little excuse for any of them to hold tight to a microphone stand and the use of fifty-seven different varieties of echo as their vocalising will probably be considered to be "square". The teenagers of 1981 will view them with interest, no doubt, while they impatiently await a colour O.B. from the moon on a 2000-line standard!

Colour

It is a pity that colour television has become a political red-herring. Electrical engineers quite rightly point to the achievements of several three-colour television systems, live or using colour telecine, which can be seen on closed circuit in Britain apart from those in regular use in America and Japan. There is no doubt that a diet of viewing colour television makes ordinary black-and-white transmission seem dull and drab by comparison. But this is a case where too much hurry may be a disadvantage. We are still tied to the 405 lines standard. If only the BBC and the Post Office had had second thoughts on the recommencement of television after the war, the Government committees concerned might also have had second thoughts and awaited international decisions on line standards in Europe and the rest of the world (excluding America and Japan) for 625 lines. The same situation seems to be arising again inasmuch as the introduction of colour TV on 405 lines may retard the changeover to a higher line standard in this country. There is no easy answer and there are other factors which have to be considered.

Microwave Links

The tremendous progress that has been made in the development of microwave links was well demonstrated in the highly successful live transmissions put out by the BBC in the complicated hook-up with Moscow—when spaceman Major Gagarin returned to that city. The triumphant scenes and speeches came over well, despite their long and complicated journey via Leningrad, Tallin, Helsinki, Stockholm, Copenhagen, Intervision, Eurovision and a standards converter. The taped replay in the evening was of exceptionally good quality, enhanced by Richard Dimbleby's explanations and commentary, which were cut in at just the right moments. True, there were times when the picture was spoiled through interference somewhere along the lengthy line of communications, the most disturbing being when the whole frame of the picture slowly rolled up. But the result was mainly of very good quality, with some first-class close-ups that were highly emotional, to say the least. I had the feeling that I was at last witnessing a step in international communication that could benefit the world by promoting international understanding. Let us hope that this occasion was the first of many international hook-ups and that the next one will be in the reverse direction.

Your PROBLEMS Solved

Whilst we are always pleased to assist readers with their technical difficulties, we regret that we are unable to supply diagrams or provide instructions for modifying surplus equipment. We cannot supply alternative details for constructional articles which appear in these pages. WE CANNOT UNDERTAKE TO ANSWER QUERIES OVER THE TELEPHONE. The coupon from p. 487 must be attached to all Queries, and if a postal reply is required a stamped and addressed envelope must be enclosed.

PETO SCOTT 1726

There is no picture, raster, or illumination of any kind on this set. There is plenty of sound and the line whistle is present, also I can draw a spark about 1in. long from the final anode lead. I have checked the ion trap magnet. There was some flashing across the face of the tube before the picture disappeared. The tube has only been in about 13 months.—W. Probert (Whitley).

You do not say how the 1in. long EHT spark was obtained, i.e. with the lead on or off the tube. If the spark was obtained "off", and had a flame-like quality, which failed when replaced on the tube, suspect the EY86. If the EHT is quite normal however, check the tube base voltages, particularly at pins 2 and 11.

PILOT TV 76

The original trouble with the above set was lack of EHT. After changing V14 and the EHT rectifier, V15, I obtained a good raster and controllable contrast and brilliance. The picture will hold vertically but the line hold only gives a divided picture with partial lock. I have since renewed V13 and V7 by local substitution, this gives a steady line lock, but still a divided or multiple image. I have a service chart for this model.—S. Barker (Redcar).

We are not sure of what is meant by "local substitution" with reference to V13. If this means that the valve now in this position is not new, this is possibly the trouble. If a new valve does not clear the effect, replace R54 (150k) and check C55, C56 and C57.

BAIRD 1675

The picture content of a horizontal band in the centre disappears, leaving the raster lines visible, or the picture vanishes, leaving closely spread blurred lines and the flyback trace. The whistle alters and the line output valve glows blue. The fault can be produced or rectified by tapping the cap of the CRT. The line output transformer has been replaced and the valves changed with no effect.—F. Goulden (Staines).

The tube has a heater-cathode short. You should fit an isolating transformer with a 2V output to supply the tube heater independently. If the transformer has a mains primary (input), the original heater leads to pins 1 and 8 must be kept separate when removed from the tube base (on no account connect together).

ENGLISH ELECTRIC 16T13

The fault on this set is a loud and continual howl, which the volume control cannot control, although it does alter the pitch of the noise. I have tried changing V4 (EF80), V15 (EF80) and V16 (ECL80) without any improvement.—A. Wiffen (Chelmsford).

The howl is no doubt due to the 100μF electrolytic capacitor in the cathode circuit of the ECL80 becoming open circuit. This is wired from pin 3 to chassis and causes positive feedback between the pentode and triode sections when defective. The loud line whistle is characteristic but the H.T. smoothing capacitor, 175μF+100μF or 200μF+100μF may be losing efficiency.

BANNER B.T. 117

This set is perfect on channel 2 but no picture or sound is present on channel 10. Could this be caused by poor contact on the channel switch or valve trouble?—S. Coates (Halifax).

You should replace the PCF80 valve on the tuner unit and then check the tuner coils and oscillator alignment if necessary.

FERGUSON 992T

The sound and vision on this set are good, but lately the picture tends to slip and some evenings it means that several adjustments of the vertical hold control are necessary. This control also has very limited adjustment. The picture tends to dim at times, which means adjustment of the brilliance control.—P. Lane (Windsor).

With regard to the poor frame hold, check by substitution valves V12 and V13 (ECL80's). Also check the 150pF capacitor connected to the triode grid of V13. The intermittent brightness could be caused by an intermittent partial short in the tube heater.

EKCO T164

When the volume control is turned on full, just before it reaches the end of its travel, there is a "plop" from the speaker and the sound disappears entirely. The picture is still present except that it is hazy. When the control is turned back a bit there is another "plop" and the sound returns and the picture becomes normal. I wish to fit a turret tuner to the model and would like to know the I.F. and the most suitable type of converter.—C. Stannard (London, S.E.10).

The usual cause of your sound fault is instability in the first sound I.F. stage, (the 6F15 besides the local oscillator) and is normally due to a faulty ceramic decoupling condenser, each of which can be checked by bridging with a good one. The I.F.'s are 16Mc/s vision, 19·5Mc/s sound local oscillator beating high, and a Cyldon U16H converter is very suitable for the job.

COSSOR 938

This set uses a 141K tube which is becoming very dim. I would like to build this set into a console cabinet and wonder if it is possible to use a 17in. tube. Will the set work with a 171K tube?—E. Hillman (Stoke-on-Trent).

Your chassis, if in good working order with adequate width, will take a 171K (or MW43/64 or 43/69) without modification. A slightly softer picture will result.

COLUMBIA

This set is about nine years old and has a turret tuner. Although I can obtain an excellent picture by adjusting the various visible controls, the top part of the picture is not visible at the top of the screen, only at the bottom. Width, linearity, vertical form, etc., are all perfect but I have not been able to correct the picture.—E. Chadderton (Oldham).

The shift control is associated with the focus assembly. Early models had two thumb screws on the focus magnet to provide vertical and horizontal shift whilst later models used a shuffle plate lever which protruded from the side of the assembly.

H.M.V. 1807A

When I bought this set it was not working, but I managed to get it going satisfactorily. It has a 10in. tube and is for BBC only. I would like to convert it to receive the ITA station. How do I set about this?—P. Smith (London, E.7).

The 1807A is a TRF model (not a superhet) and thus a turret tuner cannot easily be fitted. You will have to use an add-on converter, but a certain amount of patterning caused by BBC breakthrough may be experienced.

McMICHAEL MP17

This set has developed a bad hum which varies in volume. I have reversed the mains plug and varied the aerial without success. It is on all switch positions. Sometimes the picture vanishes and by touching the channel switch or by pressing the right side of the cabinet it appears again.—W. Jones (London, N.9).

The hum is apparently due to heater-cathode leakage in the PCL82 sound output valve. This is situated on the I.F. panel, lower right side of this panel (not of the receiver). If replacement does not effect a cure, you will have to check the electrolytic capacitors. The imperfect tuner unit contact denotes that these contacts require cleaning. The cover of the tuner unit is removed by lifting one end to clear the clips and then cleaning the clips at the other end. The centre nut can be removed to release the contact disc completely.

REGENTONE T176

Although the picture and sound are good, at times the picture disappears and the screen is a brilliant glow with three or four very brilliant diagonal lines. The sound does not fail. I changed the EY51 and this appeared to correct the fault, but after about a week the fault reappears.—T. Dinsdale (Bradford 3).

The symptoms denote a heater-cathode short in the tube. This will necessitate fitting a 6·3V heater isolating transformer.

ULTRA V814

Although a new tube and new valves have been fitted, on switching on, the scanning collapses and there is just a line across the tube. When I turn the sensitivity up, it throws a mauve light back in the U25. I replaced this but the same thing happens.—O. Laskey (Catford, S.E.6).

You should replace the 6K25 frame oscillator. If there is no difference, check the frame output valve, 20P3, and all associated resistors and capacitors. It is quite normal for the U25 to glow blue when subjected to overload.

MURPHY V240

Unless there is a close-up on the screen I am unable to focus the picture correctly. There are also black lines about ½in. wide at the top and bottom of the screen.—R. Fort (Horwich).

Your defocusing could be caused by a faulty tube or a weak U25 EHT rectifier, replacement of which will involve the renewal of the line output transformer. Insufficient height can be caused by a low 20P3 frame output valve just in front of the EHT compartment.

FERRANTI 17T4

The ITA station has given a lot of trouble since it became available in this area. The picture will not hold and keeps flicking and jumping about, then failing completely, finally disappearing altogether. The sound is also faulty. There is no trouble on BBC.—J. Auld (Doncaster).

First check the PCC84 and PCF80 base connections and then strip the tuner assembly and clean the band switch contacts. The latter are likely to be the cause of the persistent trouble. Contacts are best cleaned with a recommended lubricating fluid.

MARCONI VT68DA

The picture disappeared suddenly, leaving only a faint light, the sound is working still. When the set is switched off I can just see the spot glowing faintly, gradually disappearing. I can still make the dim light roll up the screen. I would like to know how I could test the tube and the EHT transformer. All the valves have been tested and are in order.—J. Forster (Luton).

The tube itself is most likely to be at fault but you should first check the tube base voltages. These should be; 1st anode—420V (pin 2), grid—0-60V (pin 3), depending upon brilliance setting, cathode 50-100V (pin 6), depending upon input signal. A fair spark should be drawn from U151 valve if the EHT is in order.

ALBA TV1436

This set has very good sound and raster but no picture. I checked underneath the chassis and everything looks in order. I have renewed valves

(Continued on page 487)

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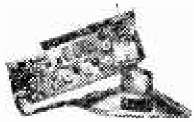

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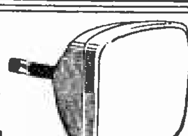

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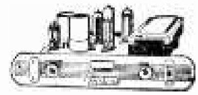

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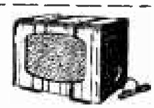

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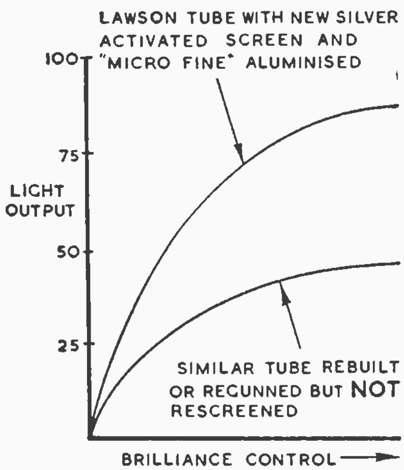

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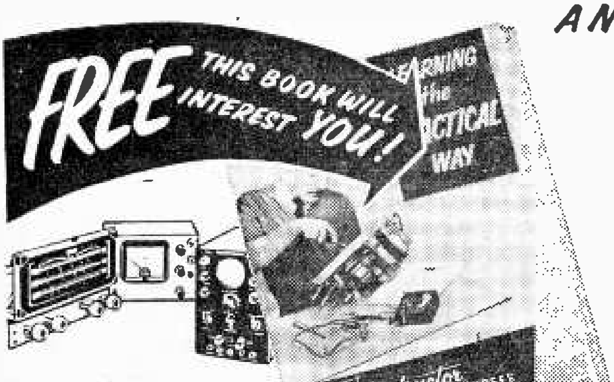

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(Continued from page 484)

on the tuner, PCF80 and PCC84 and PCF80 on video A.P. and two EF80 pentodes. The tube and the voltages at the base connector have been checked and seem to be in order. When the set is switched off there is no pin-point spot. The only thing that has appeared since the fault began is a very poor picture with a pulsatory black line. —R Eames (Goldthorpe).

You should check the GEX34 diode detector, also the limiter diode and detector choke to the video grid-stoppers (33Ω). If there is still no picture although the raster is bright when the brilliance is advanced check the H.T. supply to both I.F. amplifiers and the video amplifier.

FLYWHEEL SYNCHRONISATION

(Continued from page 458)

lines. Secondly, the grid leak R4 is returned to a point sufficiently positive to carry the whole sine wave above zero. These two precautions ensure that g3 is always at zero at a sync pulse, for any point on the sine wave can rise above zero. As soon as g1 permits conduction g3 falls to zero. Although C10 and C11 are therby charged, the short time constant and positive supply to R4 ensure that they discharge sufficiently to let g3 again be positive before the next sync pulse arrives. (Unless the next sync pulse lies a long way further down the sine wave, which condition could not be anywhere near pull-in.) Once pull-in is achieved, the capacitors receive charge continually at the tip of the sine wave and build up charge to lower g3 near to zero voltage. But, if sync is lost momentarily, the charge is lost in a few lines. In fact, operation out-of-sync is just as if g3 were always at zero voltage for all practical purposes.

In the receiver in question, the convenient source of +15V is simply the frame output valve cathode. At A (Fig. 13), we obtain the sync waveform negative-going, separated from the picture, and frame sync can be derived from this point.

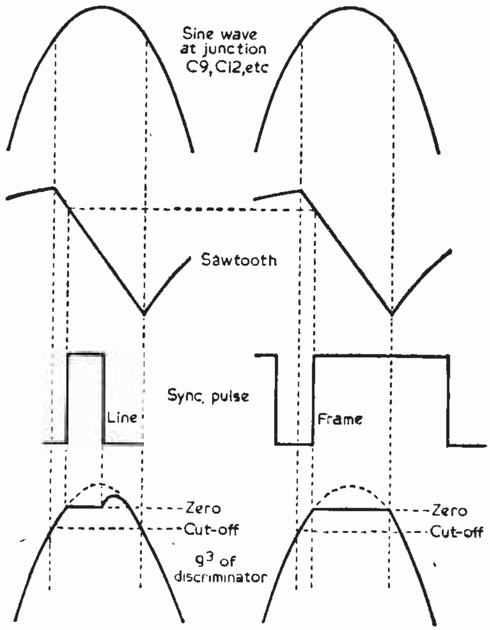

Fig. 18.—Four waveforms in the circuit shown in Fig. 13.

Performance

Again, we can compare the performance against our stated requirements. This discriminator is not balanced and noise on the sync pulse does change the output. However, apart from the flywheel filter, the effect of noise is also cut down by heavy clipping of the sync pulses by R2. Fundamentally, on interference, the performance of this circuit should be poorer than the previous one. Even if adjusted to the centre of the pull-in range, interference leads to a changed discriminator output. When interference produces at the control grid apparently long sync pulses, the rise in conduction period is limited by the g3 action. The interference that prevents g1 coming on is more serious as there is no guard against its effect in the circuit. Even so, its after effect is mitigated by g3 for when sync pulses are restored, they run through the whole (now out of sync) sawtooth in the first few lines. This produces, as we have seen, discriminator output equivalent to the centre of the pull-in range and sync is rapidly restored; g3 also guards against spurious sync pulses except when they fall very close to the real sync pulse. In the field, the circuit proved to be very successful, even in Ireland where fringe conditions are of the fringiest.

It is perhaps worth mentioning that the discriminator type of circuit with a closed control loop is not confined to flywheels; AFC of oscillators for frequency changers is another application and also the locking of colour reference oscillators for colour television receivers. The closed loop concept is the fundamental basis of all servo-mechanisms.

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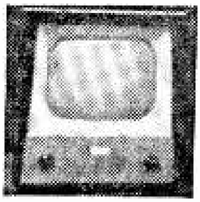

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(continued on next page)

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